PFAS Hydrogeological Study, Phase 1 Report

Desk Study, Initial Conceptual Site Model and Scope for Further Assessment

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Contents

Appendices

1 Introduction

The Government of Jersey (GoJ) commissioned Arcadis Consulting (UK) Ltd (Arcadis) to undertake a hydrogeological study and risk assessment in relation to Per and Polyfluoroalkyl Substances (PFAS) within the St Ouen's Bay and the upper Pont Marquet water catchments.

The works were undertaken in accordance with the 'Invitation to Tender (ITT) for the Provision of PFAS Hydrogeological Studies Jersey', Contract Reference: GOJ/2021/307, July 2021.

This Phase 1 report reviews existing available data to develop an initial Conceptual Site Model (CSM) that sets out potential pollutant linkages within the two catchments. The initial CSM is then used to define the scope of further assessment and monitoring to address identified data gaps and inform a subsequent PFAS hydrogeological study and risk assessment as part of Phase 2 of the study.

1.1 Project Objectives

The historical use of firefighting foams at Jersey Airport has resulted in PFAS detections in surrounding surface water and groundwater in both catchments causing impacts to drinking water supplies and a perceived public health risk, and there remain data gaps in understanding.

Hydrogeological & PFAS transport studies of two specific study areas (St Ouen's Bay and upper Pont Marquet catchment) supported by incorporation of historic and additional data is required to assess potential risks and inform remediation options.

Therefore, the works undertaken support the achievement of following overall project objectives:

- Further understand PFAS fate, transport, behaviour and assess potential risks to human health and the environment;
- Ensure safety and future security of public & private water supply;
- Build public confidence through effective communication; and,
- Help identify pragmatic and sustainable risk management options.

1.2 Report Objectives

Phase 1 of the works is a desk study and gap analysis assessment of the current information. The key objectives for Phase 1 are:

- Review currently available data including previous reports, monitoring locations, biota data, and data from government databases of relevance to the study areas to conceptualise the study area;
- Build a robust, project database of PFAS sampling and analytical data, including historic data, to support data review and visualisation;
- Visualise data layers within a Geographical Information Systems (GIS) model to facilitate identification of potential Source Pathway Receptor (SPR) linkages and identify spatial and temporal data gaps;
- Review of management values for waters and soils for other jurisdictions and provide recommendations on trigger levels;
- Production of a desk study comprising an initial CSM and Preliminary Risk Assessment (PRA) to identify and qualitatively risk rank relevant SPR linkages; and,
- Provide a scope and rationale for additional investigation and monitoring to address identified data gaps and inform subsequent PFAS hydrogeological study and risk assessment.

1.3 Reliability of Information / Limitations

Whilst this report and the opinions contained herein are accurate to the best of Arcadis' knowledge and belief, Arcadis cannot guarantee the completeness or accuracy of any descriptions or conclusions based on information supplied by third parties. A copy of Arcadis' Study Limitations is presented as Appendix A.
There are neither third party rights nor benefits conferred under this report. Use of this report if strictly limited to GoJ and its direct and indirect subsidiaries, which are the sole parties to whom Arcadis intends to confer any rights. Any reliance on the contents of this report by any other party is the sole responsibility of that party.

The remediation options evaluated have been selected to manage identified SPR linkages based on current best practice using the data available at the present time and on the findings of the current PRA. Modifications to the Conceptual Model, such as the collection of additional site data, may result in changes to the remediation options identified within this report.

1.4 Previous Reports

Previous third party reports, with relevance to PFAS, supplied to Arcadis are detailed in Appendix B.

1.4.1 Selected Report Summaries

A review of the supplied third party reports was undertaken and selected reports considered most pertinent have been summarised below in chronological order.

Hydrogeological and hydrogeochemical survey of Jersey. Technical Report WD/91/15. NS Robins and PL Smedley. British Geological Survey. 1991.

The report details the geology and hydrogeology of the island of Jersey. An assessment of 109 groundwater sources was carried out to look at hydraulic properties of sources along with inorganic and organic chemistry in the groundwater.
At the time of writing the report, it was considered that the water table is declining in some areas as full recovery cannot occur during the winter rains. The Jersey Shale is, in general, only half as productive as the volcanic rocks or the conglomerate geology within Jersey.
Modelling for abstraction from the St Ouen's aquifer indicates it could be increased as over pumping would not occur due to the head of freshwater sustaining the saline interface beneath the beach. It was concluded that the bedrock aquifers were under threat from over pumping and disperse pollution and, over time, there would be a reduction in quality and availability of the groundwater.

EPR-R-1994-09 Preliminary Groundwater Investigation, CES, September 1994

Geology underlying the airport comprises Made Ground (Hoggin type material) of unknown depth, below which is the Jersey Shale Formation. Aqueous Film Forming Foam (AFFF, supplied by 3M - Light Water AFFF used until 1993, then Angus Fire from 1993 - Angus Fire Tridol "S" 3% AFFF) was known to have been used onsite. Effluent produced during fire training exercises was a mixture of AFFF, excess fuel from the production of the training fire, and combustion products. These products were channelled by the fire training ground drainage into a soakaway via an oil interceptor sump. Surplus fuel was burned off and the rest of the effluent was discharged into a purpose-built soakaway within the Hoggin. Estimated volumes of foam used were 564l/month. Total effluent volume produced was approx. 18,800l/month. Daily discharge away from the soakaway was 6,300l but the rate at which the effluent was discharging from the soakaway into the surrounding geology was unknown. Some water/effluent from the training exercises flowed towards the surrounding permeable old roadstone. Un-combusted hydrocarbon fuel was also found in the soakaway, though the proportion soaking away from the facility into the Made Ground (hoggin) was stated to be unknown. The underlying Jersey Shale is vertically fissured thus may allow rapid transmission of effluent into the saturated zone of the aquifer (which is likely 50m bgl). Water nearby was visibly contaminated, brown in colour with a foaming substance and fuel residue. Runoff from the airport passed into the St Ouen's Sand aquifer to the west (overlying the Jersey Shale to the south).

The Jersey groundwater study, Research Report RR/98/5. NS Robins and PL Smedley. British Geological Survey 1998.

The report summarises works and measurements undertaken over seven years to assess the groundwater levels within Jersey. It estimates that the island of Jersey has a recharge rate of approximately 132mm per year to feed the main underlying aquifers beneath Jersey. It considers that approximately half of this recharge was being used by groundwater abstraction or as baseflow in surface waters. It confirms that there is only a finite water resource but there is considerable demand which might not be able to be sustained over time.

Summary of Airport FTG Contamination Investigation, JHA015, CES, March 1999.

Factual Summary Report of Progress in the investigation of contamination emanating from the Airport Fire Training Ground (JHA15). Results show the presence of fluorinated surfactants in the sand aquifer up to 1km west of the fire training ground. Both the sand aquifer and the Jersey Shale are water bearing and both units support local groundwater abstractions in the area. The sand has high permeability which allows movement of groundwater and the shale has low intergranular but moderate secondary permeability.

AFFF Calibration & Validation Briefing Note, JHA072, Harbours and Airports Committee, January 2000.

This note relates to analytical challenges experienced during the early stages of the project by the laboratory, M-scan, which had expressed numerical results on the basis of the concentration of AFFF concentrate in water because they had no information concerning the exact concentration of each component of the AFFF mixture. They had not been provided with a PFOS standard as requested of the foam manufacturer. This resulted in data from M-Scan and 3M not matching. Historic M-Scan FABMS/ESMS data only provided 'indicative concentrations of AFFF' with Limits of Detection (LOD) of 1ppm to 0.05ppm whilst manufacturer data provided 'PFOS equivalents'. In addition, M-scan used glass containers whereas 3M used plastic (HDPE) due to the propensity for materials in AFFF to adsorb to glass.

This note confirms that M-Scan obtained a PFOS standard in 1999 and then revised previous data. However, PFOS concentration data before 2000 should be considered as somewhat less reliable than subsequent data although still valuable in understanding long term trends.

Groundwater Contamination Investigation: An assessment of the impact on water quality of contaminant migration from fire fighting activities at Jersey Airport (JHA68) Post 2000. JHA068, CES, June 2000.

A sample of the primary fluorinated surfactant components of the AFFF was obtained, to be used as a standard for analysis. Results of the groundwater monitoring and analysis of water samples indicate a generally westerly groundwater flow and migration of contaminant from the fire training area. Regionally there is considered hydraulic conductivity between the blown sand and the Jersey Shale. Where clay is present in the sand, water is believed to be perched. Currently, insufficient information is available to ascertain long term AFFF trends within groundwater. No correlation was identified between salinity and AFFF concentration (AFFF not affected by short term fluctuations in inorganic water quality). Le Plat Douet is considered to form the northern limit of the St Ouen’s Bay contaminant plume. The plume is approximately 400m wide running westerly from the FTG.

AFFF was identified in stream samples feeding the Pont Marquet public supply, considered to be related to deployment of AFFF during an accident in 1980 in upper Pont Marquet catchment.

PFOS in St Ouen's Bay, JHA135, CES, October 2001.

The PFOS concentration decreases by several order of magnitude with distance from the FTG (based on measurements to approximately 1100m from FTG). PFOS dilution within groundwater identified in both the blown sand and Jersey Shale is considered to be possibly due to lateral and vertical movement within the subsurface. A correlation was identified between rainfall and PFOS concentration: The higher the rainfall, the higher the PFOS concentration. This correlation is strongest in the sand aquifer and only slightly less strong in the Jersey Shale. Overall PFOS concentrations are increasing with time in the St Ouen’s Bay area, possibly due to increased rainfall.

FTG Drain Outfall Supplementary Soil Investigation, JHA149, Marquis & Lord Consulting Scientists, April 2002.

Letter and committee briefing note on supplementary soil investigation in the vicinity of the outfall from the “85 Drain” which came from the Fire Training Ground (JHA149). The “85 Drain” outfall was sealed in April 1999 and repeat soil samples have been taken immediately beneath the outfall between 2001-2002. Results indicate a 98% decline in PFOS concentrations in soil immediately beneath the outfall (between 2001-2002). The Jersey Shale bedrock was considered to direct the discharge from the outfall along two channels away from the outfall. The soil sampling comprised hand-auger samples of the soils overlaying the Jersey Shale in the area below the former 85 drain. The soil layer thickness varied between 0.28m and 0.79m over the Jersey Shale.

11th Monitoring Report at St Ouen's Bay, JHA178, Faber Maunsell, November 2004.

St Ouen's Bay, Jersey. 11th Monitoring Report: 2004 (JHA178). In 2004 water quality monitoring took place on a six monthly basis with water levels monitored every month. Additional monitoring undertaken in relation to FTG redevelopment started in 2003 to understand baseline levels prior to the works.
Variation in groundwater levels show the greatest change during this monitoring compared to other events, with a fall of 1m in groundwater level relative to ground level. Groundwater in the Jersey Shale is more sensitive to changes in recharge than groundwater in the blown sand of St Ouen’s Bay. On the coastal plain the blown sands and Jersey Shale are considered to be in hydraulic continuity.
PFOS concentrations tend to peak approx. 2 months after heavy rainfall events. PFOS concentrations are generally higher in the Jersey Shale compared to the Blown Sands. It was also considered the increase in PFOS concentrations, since mid-2003, are due to excavations at the FTG exposing the AFFF source materials to infiltration and groundwater movement.

Jersey Airport FTG - review of groundwater monitoring 2008/2009. JHA225, AECOM, October 2009.

Groundwater abstraction for groundwater remediation at the airport included pumping from FTG BH1 and FTG BH3 (located beneath the FTG) to prevent migration of contaminated water away from the FTG. The majority of groundwater was abstracted from FTG BH1. During May 2009 the pump and cable failed and was lost down borehole FTG BH1. At the time of the report, it was expected to be replaced and pumping continued. Abstracted water is either stored in an attenuation pond for evaporation or discharged to foul sewer.

PFOS concentrations from the groundwater and surface water samples are generally consistent with some reducing trends since monitoring started. There is some evidence that remediation works at the FTG have reduced the rate of migration in groundwater and thus a reduction in groundwater concentrations hydraulically down gradient of the FTG. Surface water samples show consistent concentrations over time.

2 Study Area Details

The study area and the two catchment areas are shown on Figure 1 and Figure 2 respectively, which were defined as part of the 'ITT for the Provision of PFAS Hydrogeological Studies Jersey', July 2021.

2.1 Study Area Description

2.1.1 St Ouen's Bay

The St Ouen's Bay catchment study area is located to the west of Jersey airport and is based on an area identified as the PFOS 'Plume Area' by the Government of Jersey (15/09/2016) following previous assessments of PFOS in groundwater. Jersey Airport and the Fire Training Ground (FTG) sit on a high plateau (~85 to 90m above Jersey datum) with steep slopes dropping to the St Ouen's Bay area below. Surface water features and springs emerge around the airport boundary, including some associated with drainage outfalls and soakaways, and flow down into the bay and west towards the coastline with numerous surface water features including ponds and Simon's Sandpit. Land use across St Ouen's Bay comprises predominantly a mixture of agricultural fields and residential properties to the west of Jersey Airport with golf courses and dune landscape, including the Jersey Water abstraction borehole field, further west along the coastline.

2.1.2 Pont Marquet

The Pont Marquet stream starts on the south eastern boundary of the airport and flows in a southerly direction for approximately 1.5km where the main flow turns towards the southeast and flows for another approximately 1km to St Aubin where it discharges into the sea in St Aubin's bay. The study area is the upper catchment of the Pont Marquet stream where it is flowing in a southerly direction and includes several airport drainage outfalls, a culverted stream from St Peters Village and an aeration pond and wetland at the head of the stream. The southerly bound of the investigation is approximately where the stream turns and flows southeast. Land use across the upper Pont Marquet catchment comprises predominantly agricultural fields to the east, with the western bank initially including the airport grounds, then residential areas before becoming green space with woodland along the banks. Jersey Water abstract surface water for potable use from the Pont Marquet stream as described in Section 2.6.

2.2 Regional Topography

Figure 3 shows the topography of Jersey within and surrounding the main study area. Much of Jersey forms a high plateau with elevations between 60m to 120m above Jersey datum. The airport is approximately 85 to 90m above the Jersey datum and is located on the western edge of the plateau. The ground to the west of the airport drops off relatively steeply before levelling off closer to the coast where sand dunes have formed approximately 40 to 50m below the airport elevation. The ground to the south and east of the airport is relatively level with valleys forming where surface water features flow away from the airport. The ground drops away steeply within the valleys and at the coast in the vicinity of St Aubin where the Pont Marquet discharges into the sea.

2.3 Published Geology

Published geology is taken from British Geological Survey 1:25 000 series (Classical areas of British geology) Jersey (Channel Islands Sheet 2), 1982 Solid and Drift map (BGS, 2020) and an annotated extract of the geological map is presented on Figure 4.

2.3.1 Jersey Airport

Superficial geology

The airport location is underlain to the north and east of the airfield by Blown Sand deposits, which are considered as ‘sand that has been transported by wind, or sand containing predominantly of wind-borne particles’. Loess deposits are indicated as present east of the site, underlying the recent Blown Sands, described as Quaternary deposits of “wind-blown dust accumulations which comprise homogeneous, structureless, highly porous, buff-coloured silt.”

The eastern end of the airport footprint is shown as underlain by Made Ground. While the western end of the runway and airfield, including the fire training ground, is shown as underlain directly by the Jersey Shale Formation, it is anticipated from historical investigations that further Made Ground is also present across the western part of the airport.

Bedrock geology

The airport is underlain by the Jersey Shale Formation, comprising mudstone, siltstone, greywacke, and sandstone with a minor grit and conglomerate, all of which accumulated in a basinal turbidite environment. Locally to the airport and surrounding areas the Jersey Shale consists mainly of hard olive-green or greenish-grey mudstone and shale. The outcrop is heavily fractured with staining on fracture planes consistent with water movement. The outcrop towards St Ouen’s Bay appears to have a thickness in the order of a few thousand meters. A monitoring borehole drilled in the fire training ground proved a medium-grained sandstone to a depth of approximately 48m below ground level. The upper surface of the Jersey Shale Formation weathers to a weak mudstone or gravel of mudstone.

2.3.2 St Ouen’s Bay

Superficial geology

The area is underlain by Blown Sand deposits along the west coast of Jersey comprising sands with interbedded bands of gravel, clay and peat. Occasional Alluvium and Head deposits are present within the stream valleys and considered to be associated with surface water features. The Alluvium is largely silt grade material and the Head deposits are generally weakly sorted and comprise reworked weathered remnants of local material. Occasional Made Ground deposits, located within and overlaying the Blown Sands, are considered to be associated with sand extraction and backfilling. The area adjacent to the airport is not identified as having superficial geology but is underlain directly by the Jersey Shale.

Bedrock

Superficial deposits across the St Ouen’s Bay area are also underlain by the Jersey Shale Formation where it is recorded to mainly comprise a hard olive-green mudstone. Sandstone has also been previously proven at an approximate depth of 48m (EPR-R-2000-01 Groundwater Contamination Chronology, CE, 2000). The airport and surrounding area to the west is located on an outcrop of the Jersey Shale and this drops away from the plateau to the west of the airport at a steep gradient which shallows out towards the coast.

2.3.3 Pont Marquet

Superficial geology

The eastern area of the catchment is underlain by Loess deposits described as Quaternary deposits which are wind-blown dust accumulations which comprise homogeneous, structureless, highly porous, buff-coloured silt. Areas to the west of the catchment are identified as Blown Sands. The Pont Marquet stream and valley floor is underlain by a band of Alluvium, considered associated with surface water flow, which is predominantly underlain by the Jersey Shale bedrock or Granite in localised areas in the lower catchment. Head deposits present are poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep, mantling a hillslope and deposited by solifluction and gelifluction processes. Locally with lenses of silt, clay or peat and organic material.

Bedrock Geology

The northern area is underlain by the Jersey Shale Formation as described above. The southern and western areas of the catchment are underlain by coarse-grained granite of Corbière type, from the South-West igneous complex.

2.4 Hydrogeology

Hydrogeology taken from British Geological Survey 1:25,000 series Hydrogeological maps of the United Kingdom Jersey (Sheet 22), 1992 with an annotated extract presented as Figure 5

2.4.1 Airport

The airport area is underlain by the Jersey Shale Formation which is considered to be a productive strata for water abstraction.

The Jersey Shale Formation consists of highly indurated very fine to medium-grained sandstone units with subordinate mudstones and conglomerates, metamorphosed to low greenschist facies. Secondary permeability is available in the uppermost 40m derived from faults, fractures, dilated bedding planes and cleavage. Mean sustainable yield of boreholes is 0.6 l/s ranging from 0.1 l/s to 1.2 l/s. Hydraulic conductivity is of the order of 1 to 10 m/d and specific yield 10^{-4}.

2.4.2 St Ouen’s Bay

The catchment area is underlain by Blown Sands followed by the Jersey Shale Formation. Both are considered productive strata for water abstraction with public and private abstractions identified.

The Blown Sands are considered to be a shallow productive aquifer at St Ouen’s Bay. They have a maximum saturated thickness of 8m towards the coast. Away from the coast the sand thickness reduces and becomes dry with elevation towards the airport in the east. Five public supply boreholes are in the vicinity of maximum thickness close to the coast and each yield from 1.9 to 6.3l/s with a maximum available drawdown of 7.4m. Average daily abstraction from the well field is 1,500 m^3/d but an additional 600 m^3/d is available before imposing any stress on the saline interface just beyond the sea wall. The hydraulic conductivity of the sand is 5 m/d and the specific yield is 0.2.

The Jersey Shale Formation consists of highly indurated very fine to medium-grained sandstone units with subordinate mudstones and conglomerates, metamorphosed to low greenschist facies. Secondary permeability is available in the uppermost 40m derived from faults, fractures, dilated bedding planes and cleavage. Mean sustainable yield of boreholes is 0.6 l/s ranging from 0.1 l/s to 1.2 l/s. Hydraulic conductivity is of the order of 1 to 10 m/d and specific yield 10^{-4}. The water table varies from approximately 2.2m below ground level (bgl) in the east to approximately 13.5m bgl in the west.

Groundwater flows regionally in a westerly direction from the higher plateau level (the airport) towards the lower elevation at the coast. This groundwater flow is consistent with the emergence of groundwater in the beach below the sea wall. Local groundwater flow, closer to the coast, has been impacted by sand extraction processes and the public water abstraction boreholes (when running).

2.4.3 Pont Marquet

The Pont Marquet catchment is underlain by the Loess deposits to the east which are considered to be above the water table and unproductive strata (with regard to groundwater abstraction). The west of the catchment is underlain by Blown Sands which is considered to be productive strata. The whole of the catchment is underlain by the Jersey Shale Formation which is considered to be productive strata for groundwater abstraction.

The Jersey Shale Formation is consistent with details presented for St Ouen's Bay above.

Groundwater flows regionally to the South and Southeast from the airport area towards St Brelade and St Aubin and the coastline.

2.5 Hydrology

The stream catchments are presented on Figure 6 and summarised below.

2.5.1 Rainfall and recharge

Average rainfall across the island of Jersey varies from less than 775mm in the southwest of the island to greater than 925mm in the north east of the island in the parish of Trinity. (BGS Hydrogeological and Hydrogeochemical survey of Jersey). The average annual rainfall for Jersey between 1951 & 1980 was 877mm. (Aecom Review of 2008-2009 results).

Data from the airport weather station, for between 1999 and 2021, shows an average rainfall of 905mm, with a minimum of 732mm (2011) and a maximum of 1104mm (2020) (airport data provided).

2.5.2 St Ouen's Bay

Surface Water Features

The principal surface water features identified in the St Ouen's Bay study area are:

- The lagoons at Simon's Sand Pit;
- The ponds on Les Meilles Golf Course;
- St Ouen's Pond;
- Pond at Les Ormes Golf and Leisure Village (Creepy Valley Activity Centre);
- Stream north of the airport along the Mont Du Jubilee valley running to Les Meilles Golf course with input from the North and Northwest drainage outfalls;
- Stream southwest of the airport running to the pond at Les Ormes Golf and Leisure Village with input from the South Southwest drainage outfall; and
- Springs at the base of the airport slope.

The identified ponds and lagoons are considered to be in hydraulic continuity with groundwater in the sand aquifer and possibly with the Jersey Shale groundwater.

The ponds at Le Meilles Golf Course are considered to be interconnected with underground pipes to control water movement. This results in movement that varies from the regional direction of groundwater flow.

Several watercourses appear at the ground surface on the outcrop of the Jersey Shale and flow in a westerly direction towards the coast.

Several of the streams appear and disappear below ground during their course to the coast but one of the most consistent streams takes water from two tributaries; the Val de la Mare reservoir and the Mont du Jubilee valley. While the two tributaries can have intermittent flow the lower stream has a constant flow to the west into a pond (likely owned by the National Trust) which feeds further ponds at Les Meilles golf course. Flow into the ponds at Les Meilles golf course is understood to be via a pipe valve, with surface water then flowing in a northerly direction into the St Ouen's Pond before discharging into the St Ouen's Bay.

The Mont du Jubliee valley stream is partially fed from an outfall from the airport and other areas where water appears at the surface. At various stages it has either been culverted or it submerges below ground. It is understood that field drainage from areas to the north and west of the airport also feed into this stream.

The remaining watercourses are intermittent and generally only flow in the winter and spring months where higher rainfall and increased runoff is expected. During the drier summer months there is intermittent flow which generally follows periods of heavy rain.

Various drainage ditches and partial watercourses are shown to the west and south of the airfield which are considered to be above the groundwater level within the Jersey Shale or sand aquifers. It has been inferred by others that these streams flow on clay bands which restrict the leakage of water from the streams to the main water table. It is conceptualised that the streams sink to ground at the western limit of the clay bands. (Harbours and Airports Presidents Briefing Notes July 1999).

The underlying ground in the St Ouen’s study area is a mix of Blown Sand, Head deposits and Jersey Shale which has an impact on the infiltration of rainfall events. It is considered that where rain falls on the Blown Sand aquifer there will be direct infiltration, while rain falling on the Head deposits and Jersey Shale would have significant run off before infiltration to the Sand at lower levels, enhancing recharge to the Sand aquifer.

2.5.2.1 Jersey Airport Drainage

The location of stormwater drainage outfalls and the associated area of drainage infrastructure are shown on Figure 7, taken from the Jersey Airport Preliminary Risk Assessment (Mott Macdonald, 2021) which also includes a more detailed drainage plan.

Rainfall on the western part of the airfield is understood to either drain in a northerly direction via an oil interceptor prior to discharge in the Le Mont du Jubilee valley (North and Northwest Outfalls) or in a westerly direction via soakaways above the Le Mont Fondan valley in the southwest corner of the airfield (West Soakaway and South West Soakaway). It is considered likely that water fromthe soakaways appears in the stream in the Le Mont Fondan valley.

Water from the southsouthwest apron is understood to be directed to an oil interceptor and reedbeds on the southern edge of the airport (South Southwest Outfall) where it flows via an open ditch to a pond at the Les Ormes Golf complex. The pond, while above the water table, is considered to provide recharge to the sand aquifer in the region to the east of Simon’s Sand Pit.

2.5.3 Pont Marquet

Surface water features

Information regarding drainage outfalls is based primarily on the Jersey Airport Drainage Plan (April 2016), data collected during site visits undertaken by Arcadis in August 2021 and other information supplied by Jersey Airport and the GoJ.

There are three separate inputs to the head of the Pont Marquet stream including the Eastern Outfall (with an associated aeration pond and reedbed which can be used to treat contaminated surface water runoff), a second drainage outfall from Jersey Airport and the outfall from a culvert running under Jersey Airport from St Peter’s Village. The outfall from the aeration pond and reedbed joins the stream approximately 120m downstream of the head of the stream.

An unnamed surface water stream is shown flowing west to east from the airport in this area but is not marked as an outfall and may be historical or an ephemeral spring.

Two water bodies (ponds) located on the upper Pont Marquet adjacent to the Barchester Lakeside Care home are considered likely to be fed from water discharging from the combined discharges further upstream. The Southeast Outfall is shown discharging to the stream shortly south of the two ponds. Water from the two ponds then flows south along the water course above the Alluvium that overlies the Jersey Shale.

The South Outfall discharges to a small tributary which emerges from the airfield and flows southeast for approximately 400m before it joins the flow approximately 200m downstream of the two ponds to the north.

The combined stream then continues to flow for a further 1km (approx.) before further tributaries join from the northeast and the west just north of Rue du Pont Marquet. The tributary from the west flows for approximately 650m adjacent to the former railway track and through Pont Marquet Country Park where it is understood that there are ponds within nearby fields. The tributary from the east flows from the northeast for approximately 700m between Rue du Conet and Rue des Fosses a Mortier with a pond shown approximately 100m to the northeast of the junction of La Rue des Mans and La Rue du Conet. Based on the elevation and the stream overlying the Alluvium it is not clear if there is interaction with the underlying Jersey Shale.

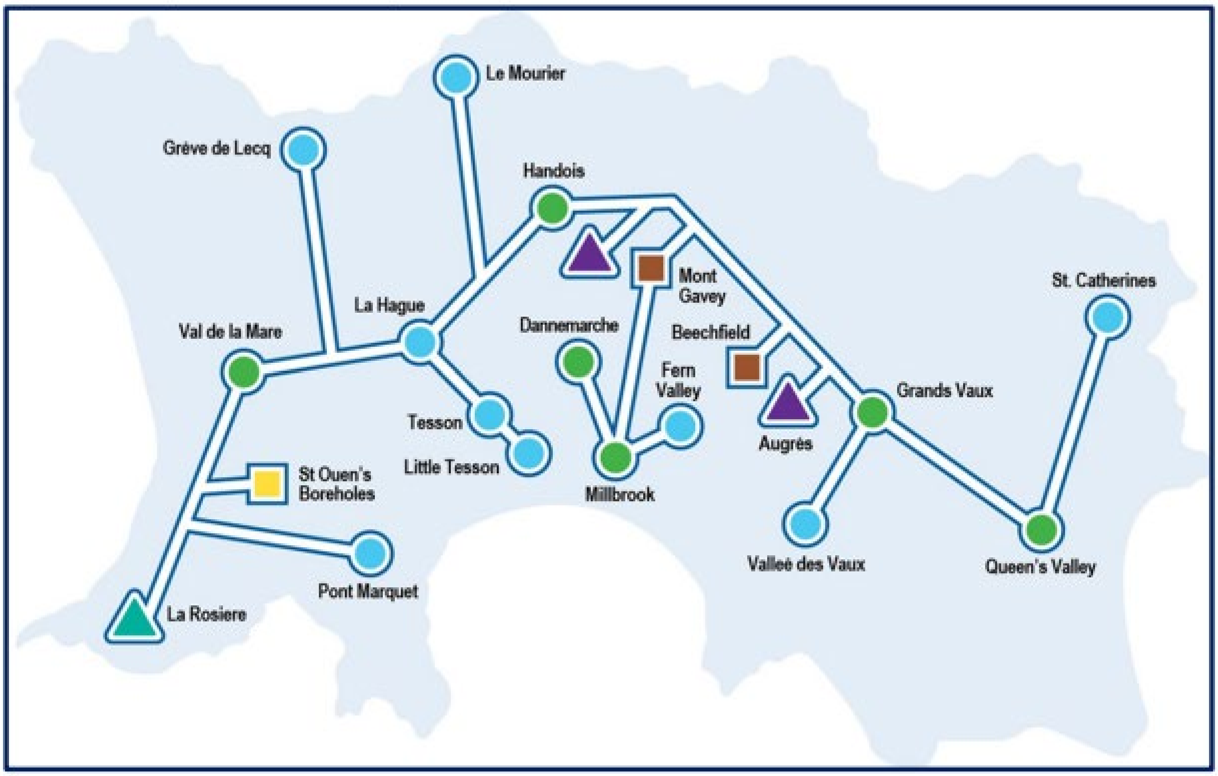
The stream flow is split south of Rue Pont Marquet with the main stream flow running down to St Aubin and into St Aubin's Bay and the diverted stream running to the Jersey Water surface water abstraction point and associated infrastructure. Surface water which is not abstracted is then returned to the main stream flow.

The location of stormwater drainage outfalls and the associated area of drainage infrastructure are shown on Figure 7 which is taken from the Jersey Airport Preliminary Risk Assessment (Mott Macdonald, 2021) which also includes a more detailed drainage plan.

2.6 Drinking Water Supply Network

An overview of the Jersey Water (JW) drinking water system and raw water assets is shown below (reproduced from the Jersey water, Water Resources and Drought Management Plan, 2021).

Figure 3-1 Jersey Water Resource System: Key Raw Water Assets



Key: reservoir (green circle); stream abstractions (blue circle); groundwater boreholes (yellow square); desalination plant (blue triangle); balancing tanks (brown square), and water treatment works (purple triangle)

The JW resource and drought plan (Managing the Island's Water Resources Planning for the future, 2021) identifies the effects of climate change and population, on the water resources available and the demand for water in Jersey, over the next 25 years. The information in this report identifies that if no action is taken to reduce the demand for water and increase the supply of water, then by 2045, there will be a shortfall 8 million litres per day) in the availability of water, in the event of a severe drought.

JW presently own five small boreholes located in the southern part of St Ouen's Bay area. These boreholes can abstract on average 1 million litres per day from the water bearing sand aquifer. JW estimate that the potential rate of water abstraction represents only 20% of the total underground flow of water that ends up in the sea. The abstracted water is pumped into the nearby Val de la Mare Reservoir, for blending with surface waters, prior to undergoing normal treatment and distribution via the public mains water system. It should be noted that these boreholes are currently out of use due to the PFAS contamination.

It is noted by JW that historical firefighting foam use at Jersey Airport has led to detections of PFOS and PFOA in groundwater across St Ouen's Bay and that the Pont Marquet catchment stream is also affected, albeit at lower levels. Currently, the abstraction rate from the St Ouen's well field has been stopped from around 1 million litres per day to minimise the risk of the PFAS plume being pulled towards the well field, and ensuring drinking water supplies continue to meet current standards. The need to increase water supply while protecting human health within a context of tightening drinking water standards provides a key driver for this study and the identification of options to assess and address potential risks from PFAS.

Subject to PFAS concentrations, JW plan to investigate the possibility of increasing the volume of water taken from the St Ouen's Bay groundwater source, including the sinking of additional boreholes in the adjacent area. Preliminary work by JW indicates that an additional 1, or possibly 2, million litres of water per day can be abstracted sustainably and with no detriment to the environment or ecology of the area.

Through the development of the JW Water Resources and Drought Management Plan various options were considered to make up the shortfall in supplies by 2045.

JW concluded that the best way to do this is through a combination of measures to reduce overall demand for water and to ensure sufficient drinking water is available in a drought situation. The measures include water efficiency and leakage control, expansion of the desalination plant, catchment management to reduce pollution risks and addressing the risks association with the PFAS contamination at the St Ouen's boreholes. The below info graphic is taken from the JW resource and drought plan (2021).

2.6.1.1 Public Water Supply Abstractions

JW operate five groundwater abstraction boreholes (A1 to A5) located in the well field area to the south of Simon's Sand Pit, adjacent to Chemin des Basses Mielles and Rue de la Pulente. The boreholes were installed between 1974 & 1982 and range in depth from 13.1 to 18.3 m bgl. Water abstracted from these boreholes was pumped into the Val de la Mare reservoir to the north of the airport.

JW records show that between 2010 and 2019 an average of 121.13 million litres per year was abstracted from the wellfield. The maximum annual abstraction was 181.29 million litres in 2010 and a minimum abstraction of 63.81 million litres in 2012. During 2020, 26.99 million litres were abstracted from the well field. However, as noted above, the pollution of St Ouens boreholes and Pont Marquet with PFAS presents a significant raw water quality challenge which restricts their use and JW's ability to extract water from them. Arcadis understands the current strategy is not to use these sources unless in significant drought. In such circumstances, the sources will only be used when the desalination plant is also in use to provide the significant blending required to minimise the impact on the quality of raw and treated water. These sources are currently out of supply.

Based on previous works by CES (Jan 2000) it was concluded that there are three main recharge sources for the well field. The primary source is rainfall to the sand in the vicinity of the boreholes and to the south and east. Additional sources are the Creepy Valley Pond and Simon's Sand Pit.

JW operate a pumped stream catchment for Pont Marquet which feeds water into the Val de la Mare reservoir. The abstraction from the catchment has a maximum pump capacity of 260m^3/hr and 6.24 million litres/day.

2.6.1.2 Private Water Supply Abstractions (Licensed and Unlicensed)

The GoJ Water Resources database holds details of water supplies that are registered or licenced for the abstraction of surface water or groundwater. These have been included within the GIS model and presented as Figures 8 & 9.

St Ouen's Bay

A total of 119 boreholes are detailed in the Water Resources Database for the St Ouen's study area. Of the 119 boreholes, 78 are listed as not used for abstraction which included 8 used for water level monitoring and 12 for site investigation works. The remaining 41 boreholes are listed as active and used for business, gardening, house supply, pool, amenity, etc.

A total of 5 Dam/Ponds are detailed with 4 listed as active for water abstraction for either business or agricultural use.

One surface water (stream) abstraction is listed for the Val de la Mare stream.

Two wells are listed with one classed as active for garden watering and the second listed as not active but used for groundwater monitoring.

Pont Marquet

A total of 77 boreholes are detailed in the Water Resource database for the Pont Marquet study area. Of the 77 boreholes, 67 are listed as active and detailed as being used for many uses including businesses, household, amenity, garden & stables, agricultural livestock watering, etc. The remaining 10 boreholes are not listed as active with 3 of them identified during a site investigation and soak away test.

One dam/pond is listed but is not shown as active.

Two stream abstraction points are licenced and shown as active.

Three trial pits are detailed but none of them are listed as active as groundwater was not encountered.

A total of 34 wells are listed with 24 of them detailed as active and used for house supply, garden watering, amenity (public use), business, etc. The remaining 10 locations are not listed as active.

2.7 Ecological sensitivity

St Ouen's Bay is within the Coastal National Park and also includes an Ecological Sites of Special Interest (SSI), known as Les Blanches Banques which covers land surrounding St Ouen's Pond and the land to the south of Simon's Sand Pit.

Simon's Sand Pit and St Ouen's Pond are classed as ponds of ecological importance with St Ouen's Pond (La Mare au Seigneur) comprising a wetland area with numerous waterfowl.

The main stream running into, through and out of the Val de la Mare reservoir to the coastline is listed as a stream of ecological importance. (Jersey Government Blog - SSI).

3 ESDat Database and GIS Model Development

3.1 Approach to Data Management and Visualisation

Arcadis took the approach to combine various provided data sets into one database to allow for a consistent approach to data management going forward.

3.2 ESDat Database Development

3.2.1 Sources of information

3.2.1.1 Government of Jersey Databases

Database exports from the following databases were provided.

- Water Resources Database – the data provided from this database contained details of water abstraction points including boreholes, wells and streams. The interpreted geology for the screened sections of the boreholes were also provided along with depths of boreholes and groundwater if recorded.
- WISKI Environmental database (stored in a database utilising the WISKI application developed by KISTERS) – The data provided from this database contains groundwater and surface water monitoring data with laboratory chemical analysis. Two separate files were provided. One file contained chemical analysis data, separated by chemical compound. The second file contained location information, including location co-ordinates and descriptive location information. A common *Station number* identifier provided a link between the location information and chemical analysis data.

Key information from the Water Resource Database and WISKI database information was captured into a single database, utilising the ESdat database software.

The two databases work on different nomenclature systems for location naming. The WISKI Environmental database location name was identified under a field named *Station number.* Whereas the Water Resources Database location name was identified under a field named *Source_ID.* As the *Station number* and *Source_ID* do not align, a matching exercise was undertaken to be able to link the information from the two databases. This was completed using the station name/address and the grid coordinates for the source or sampling location.

The WISKI Environmental database *Station number* has been adopted as the primary location identifier. In a limited number of instances where a WISKI Environmental database *Station number* has not been assigned by GoJ for a sampling location, the Water Resources Database location *Source_ID* has been adopted.

3.2.1.2 Additional Laboratory Certificates of Analysis

In addition to the laboratory data provided in the WISKI database, GoJ provided 43 laboratory certificates of analysis of additional data. The certificates of analysis included groundwater and surface water monitoring data with laboratory analysis, plus additional biota data from coastal locations. The majority of these certificates of analysis were provided in a PDF format. As such, a digitisation exercise was undertaken to capture this data into a single database with the Water Resources Database and WISKI Environmental database information.

3.2.1.3 Additional Groundwater Data

GoJ provided other laboratory data in the form of laboratory certificates showing analytical results, the methodology for the analysis and the method detection limit for the analysis.

3.2.1.4 Jersey Airport Site Investigation Data

Data was provided from the Jersey Airport Site Investigation works undertaken by Mott MacDonald in 2022. The full report was not available at the time of writing this report.

Data will be included in future works and risk assessment.

3.2.2 Data Quality and Assurance Checks

The collated data underwent a process of quality assurance checks. This included 'sense checks' of the data such as looking for completeness of data, outliers in the laboratory data or where incorrect location coordinates may have had been entered. Spot checks were also undertaken by comparison of the collated data with the original data (either database or laboratory certificate).

Where there were uncertainties in matching the WISKI Environmental database *Station number* with the Water Resources Database *Source_ID*, GoJ were consulted. If uncertainties remained, this was noted in the location information as applicable. GoJ were also consulted to help identify 'parent' locations for 'orphan' samples identified in order to maximise the amount of available data for spatial visualisation.

3.2.3 Assumptions

The development of a single data source within the ESdat database required interpretation and review of the Water Resources Database and WISKI Environmental database. In undertaking this process, a number of assumptions were made which are summarised below:

- It is assumed that the laboratory analysis methods used are robust and correctly identify the presence or absence of PFAS compounds.
- On a number of the additional laboratory certificates of analysis, method detection limits (MDL) are not stated for all PFAS compounds. Assumptions have been made based on typical MDL in the wider dataset.
- The suite of PFAS compounds with the data provided has been assigned to 23 separate reference chemical compounds in the ESdat database. For the majority of compounds, a Chemical Abstracts System (CAS) number is provided, which provides a high degree of certainty when matching analytical data to reference chemicals in the database. However, for some compounds a CAS number is not provided, and the matching is based on the PFAS chemical naming conventions which are less clearly defined.
- Where a CAS number is not provided, the data provided uses a number of different PFAS compound naming conventions at different points in time. Where appropriate, inference has been made that analytical data listed under different names relates to the same reference chemicals in the database.
- The process of matching the WISKI Environmental database *Station number* with the Water Resources Database *Source_ID* has been undertaken to the best of Arcadis' ability. The process involved both a spatial matching exercise by visually comparing the two datasets on a plan, and by a text-based exercise, manually matching common terms and location references. As such, there remains the potential for mismatching between the datasets. However, due to the way the data is being utilised, it is considered unlikely to have a material impact on the assessment.
- The WISKI Environmental database contains samples noted as being taken from tap water and drinking water supply tanks. Where this can be clearly identified, this has been flagged in the dataset so that the data can be omitted. There is potential that these samples are not representative of the

surrounding environmental quality (groundwater or streams) as the water obtained may be subject to treatment or from mains water. There remains the possibility that further tap water or drinking water supply tank samples are present which cannot be readily identified.

- The aquifer unit screened within monitoring wells has been assigned based on the Water Resources Database information. A review has been undertaken against the geological mapping to confirm that the geological unit assigned corresponds. However, in the absence of original borehole installation records, the accuracy of the inference cannot be fully validated.
- A number of 'orphan' samples remain where the location of the sample cannot be confirmed. This represents a small proportion of the overall dataset and the remaining data is considered sufficient to undertake the evaluation presented herein.

3.3 GIS Model Development

To be able to understand the spatial distribution of PFAS concentrations across the study areas as it changes over time, the data was input into a GIS model to allow easy manipulation and visualisation of the data.

3.3.1 Sources of Information

3.3.1.1 Arcadis ESDat Database

The data, as detailed above, was collated into an Arcadis hosted database utilising the ESdat application developed by EScIS. Data was exported from the ESdat database to allow the creation of layers within the GIS software.

3.3.1.2 Publicly Available Datasets

A search of publicly available GIS data sets in relation to Jersey was completed and the following identified for inclusion in the GIS model.

- BGS solid and drift geology and hydrogeology maps.
- GoJ Island Plan data taken from ArcGIS feature server.
- GoJ shared data sets including water management areas, ground level contours, road and stream centrelines.

3.3.1.3 Jersey Water Datasets

GIS data was supplied by Jersey Water, to cover their raw water and treated water pipe network in the water management areas 6 and 7 (which include the study area).

- Public water supply network for treated water in water management areas 6 & 7.
- Water supply network for raw water in water management areas 6 & 7.

3.3.2 Assumptions

Where data has been sourced from a publicly available GIS database this has been used with the source of the data identified.

Where data has been supplied by the GoJ or Jersey Water this is on the understanding the data will be used as part of this assessment and confirmation would be needed prior to making the data available to the public.

Where data has been provided it is either in the Jersey coordinate system (Jersey Transverse Mercator) or can be converted to World Geodetic System (WGS84) coordinate system which is compatible with the Arc GIS software utilised in this study.

The GIS model has been created with data based on attribute tables that can be updated from spreadsheets. This data will be manually updated and no automated update is possible due to the restrictions on external use of the Arcadis database.

3.3.3 Data Quality and Assurance Checks

The data shown within the GIS model was checked against original data taken from reports and laboratory certificates. Spot data points were also taken from the supplied GoJ databases checked within the GIS model.

The supplied Jersey Water data was also checked for consistency with roadways and known points of interaction within the infrastructure of the island.

4 Initial Conceptual Site Model Development

4.1 Scope of Conceptual Site Model

The aim of this phase of works was to develop an initial, high level Conceptual Site Model (CSM) for the St Ouen's Bay and Pont Marquet catchments to identify potentially active source, pathway, receptor (SPR) linkages and assess any data gaps. The CSM and identification of data gaps is required in order to inform requirements for additional data collection sufficient for the planned hydrogeological risk assessment and numerical modelling.

4.2 Approach and Assumptions

The focus of the planned hydrogeological study and risk assessment will be SPR linkages associated with the migration of PFAS from firefighting foam sources on Jersey Airport via groundwater and surface water across the two catchments which have the potential to affect drinking water and surface water resource receptors. While other potential SPR linkages have been identified through this process (and outlined below), these may require separate studies to further assess, which are outside the scope of this work.

Human exposure pathways via dust inhalation and direct contact in relation to airport workers have not been included within the hydrogeological risk assessment but are understood to have been assessed as part of the Jersey Airport investigation works.

The sources, pathways and receptors and the associated numbering have been aligned, as far as possible and relevant, with those identified as part of the Jersey Airport Preliminary PFAS Risk Assessment (Mott Macdonald, February 2021), reviewed by Arcadis, in order to support a clear and coherent conceptualisation of the two catchments for GoJ and other stakeholders.

4.3 Potential Sources of Contamination

The following potential PFAS sources have been identified:

S1 Residual PFAS impacts within unsaturated soils beneath the Fire Training Area (FTA) associated with historical firefighting foam usage.

PFAS contaminated soil previously excavated from the Fire Training Area currently contained within an engineered bund is not considered to represent a current potential source provided long term management and monitoring ensures bund integrity.

S2 Historical PFAS impacts within unsaturated soils across Jersey Airport and select off airport locations associated with previous firefighting foam usage, spillages and soil movements

S3 PFAS within saturated soils and groundwater

S4 Land spreading of biosolids within the catchments – exact locations currently unknown

S5 Historical landfills within St Ouen's Bay - deposited waste types and age currently unknown

S6 Localised PFAS sources / discharges in the vicinity of St Aubin

A detailed review of all potential PFAS sources across the two catchment areas has not been undertaken as part of this study which is focussed primarily on PFAS sources, pathways and receptors associated within use of firefighting foams at Jersey Airport. However, where identified, potential additional PFAS sources have been noted (S3 to S5) although these are anticipated to be of lower significance compared to airport sources. Further assessment of potential additional sources could be undertaken if additional data indicates these may be significant.

Following liaison with Dr Paul Gibbs (PAG Consultancy, July 2022) it is understood that St Ouen's Bay and Pont Marquet catchments have not been heavily used for biosolids spreading over the last 10 years with the exception of a few fields. Identification of these fields, as well as the magnitude of biosolids application, is understood to be under development by Dr Paul Gibbs and so can be included within subsequent updates to the CSM.

4.3.1 PFAS in Firefighting Foams

The exact type and quantities of firefighting foams used at Jersey Airport are not known but have been referenced in historical reports as '3M - Light Water Aqueous Film Forming Form (AFFF) used until 1993, then Angus Fire from 1993 - Angus Fire Tridol "S" 3% AFFF (EPR-R-1994-09 Preliminary Groundwater Investigation, 1994). This report also states that the following:

"*Effluent produced during fire training exercises is a mixture of AFFF, excess fuel from the production of the training fire, and combustion products. These products are channelled by the fire ground drainage into a soakaway via an oil interceptor sump. Surplus fuel is burned off and the rest of the effluent is discharged into a purpose built soakaway within the Hoggin. Estimated volumes of foam are 564l/month. Total effluent volume approx. 18,8000l/month. Daily discharge away from the soakaway is 6300l but the rate at which the effluent is discharging from the soakaway into the surrounding geology is unknown*."

Analysis of 3M AFFF formulations (1989–2001) by Backe et al (2013) is below and annotated by Arcadis.

		1989 mg/L	1993a mg/L	1993b mg/L	1998 mg/L	2001 mg/L
Precursors	PFBSaAm*	9	120 ± 2.0	180	140	110
	PFPeSaAm*	8	140 ± 1.8	180	140	110
	PFHxSaAm*	189	660 ± 8.1	850	743	690
	PFHpSaAm	ND	12 ± 0.40	15	30	24
	PFOSaAm	9.9	62 ± 1.1	75	67	37
	PFBSaAmA*	ND	140 ± 3.1	120	110	150
	PFPeSaAmA*	4	200 ± 6.3	170	140	130
	PFHxSaAmA*	ND	930 ± 13	850	850	960
	PFHpSaAmA	ND	17 ± 0.16	17	34	44
	PFOSaAmA*	ND	72 ± 0.81	58	53	65
Shorter Chain Perfluoroalkyl Acids (PFAAs)	PFBS	380	220 ± 2.0	160	210	250
	PFPeS	210	120 ± 1.5	80	90	120
	PFHxS	1700	910 ± 14	760	850	900
	PFHpS	410	120 ± 2.0	120	93	140
	PFOS	15000	8000	9300	6700	7900
	PFNS	160	53 ± 0.97	56	9	27
	PFDS	102	51 ± 0.34	52	11	27
Shorter Chain Perfluoroalkyl Acids (PFAAs)	PFBA	37	24 ± 0.48	35	31	38
	PFPeA	47	36 ± 0.14	52	43	48
	PFHxA	170	99 ± 1.1	110	99	170
	PFHpA	54	25 ± 0.28	22	26	37
	PFOA	150	83 ± 1.3	93	86	170
	PFNA	ND	ND	ND	ND	ND
	PFDA	ND	ND	ND	ND	ND
	PFUdA	ND	ND	ND	ND	ND
	PFDoA	ND	ND	ND	ND	ND
	PFTrA	ND	ND	ND	ND	ND
	PFTeA	ND	ND	ND	ND	ND
	PFS/PFA[b]	39	35	34	28	20

% Precursors	1.2	19.5	18.8	21.9	19.1
% PFOS	80.5	66.1	69.6	63.5	65.0
% Shorter Chain PFAAs	18.3	14.4	11.5	14.7	15.9

It is understood that C6 fluorotelomer foams were used at Jersey Airport following the FTA redesign in 2004 but that firewater generated from this time (to present) was contained.

4.4 Potential Pathways

The following potential PFAS migration and exposure pathways have been identified:

P1	Vertical migration of PFAS through unsaturated soils to perched water and underlying groundwater via soil leaching associated with historical soil impacts and soakaways
P2	Lateral migration of PFAS within perched water to identified surface water receptors e.g. as springs
P3	Vertical and lateral migration of PFAS within groundwater to identified surface water receptors (including inland freshwater and the coastal marine environments) and groundwater abstractions
P4	Preferential pathways associated with airport drainage including the discharge of PFAS within stormwater to identified surface water receptors via drainage outfalls
P5	Surface Water Runoff
P6	Lateral migration of PFAS within surface water including streams, tributaries and ponds
P7	Abstracted groundwater used for crop and food irrigation and livestock feeding and direct plant uptake

4.5 Potential Receptors

The following potential receptors have been identified:

R1	Jersey residents consuming mains public water supply – a blend of sources which only in exceptional circumstances may contain water abstracted via boreholes within the St Ouen's Bay Blown Sand aquifer and via the surface water abstraction from the Pont Marquet stream, when Jersey Water are certain that water quality standards would be met
R2	Occupants of nearby residential properties consuming abstracted groundwater
R3	Groundwater within the St Ouen's Bay Blown Sand aquifer
R4	Groundwater within the Jersey Shale Formation
R5	Surface water – water filled pits, outfall drains and streams
R6	Surface water – coastal marine environment
R7	Consumers of crops, foodstuffs and livestock where there is a potential for PFAS impacted soil, biosolids, irrigation water or feed water to have been involved
R8	Ecological receptors including biota within inland freshwater and coastal marine environment

It is noted that in relation to ecological receptors, while testing of limpets, oysters and seaweed has been previously undertaken (described in Section 6.3) a detailed review of potential habitats and ecological receptors has not been undertaken. Similarly, specific potential food chain related receptors would require separate further assessment to assess potential exposure pathways and receptors.

4.6 Potentially Active Pollutant Linkages

The potentially active SPR linkages are summarised in Table 1 which constitutes a key element of the initial CSM. The table also provides initial qualitative risk assessment for each potential pollutant linkage identified based on the estimated probability of contaminant exposure and the severity it may have on identified receptors.

Figures 10 and 12 provide plan view visualisations of the St Ouen's Bay and Pont Marquet catchments showing the conceptualised SPR linkages. In addition, Figures 11 and 13 show schematic geological cross sections across the St Ouen's Bay and Pont Marquet catchments, respectively, annotated with conceptualised SPR linkages.

Additional comments on the initial CSM and SPR linkages are provided below.

St Ouen's Bay Catchment

- Arcadis understand investigation of potential PFAS sources on Jersey Airport is underway and have included identified potential source areas from the Preliminary PFAS Risk Assessment (Mott Macdonald, February 2021). The initial CSM is intended to be updated following completion and interpretation of these works by Mott Macdonald;
- While multiple sources of PFAS are understood to be present on (and around) the Jersey Airport site, the primary PFAS source is still anticipated to be residual contamination beneath and around the FTA given the magnitude of historical fire fighting foam usage in this area;
- Elevated PFOS concentrations are measured in the Blown Sands immediately at the base of the airport's western slope, aligning with the boundary of the Blown Sands superficial deposits, indicating that PFAS migrating down from the airport plateau via the Jersey Shale enters the Blown Sands aquifer almost immediately;
- While PFOS concentrations are relatively low along the Mont du Jubilee stream they increase when the stream reaches the Blown Sand Aquifer in St Ouen's Bay indicating continuity with groundwater & potential PFAS ingress into surface water;
- Conversely, several surface water features appear discontinuous or end before reaching the coast, notably the spring from base of airport slope with elevated PFOS concentrations, indicating some surface water features may drain into the sand aquifer;
- PFOS concentrations in the Jersey Shale reduce across St Ouen's Bay while PFOS concentrations in the Blown Sands remain elevated up to the coastline in some areas indicating preferential flow within Blown Sands;
- Elevated PFOS concentrations are measured within Simon Sandpit and other surface water features across St Ouen's Bay with elevated groundwater concentrations hydraulically down gradient of these features compared with similar, adjacent locations within the plume. This indicates that Simon Sandpit and other surface water features may be influencing (facilitating) groundwater flow and hence PFOS migration.

Pont Marquet Catchment

- From previous site visits undertaken by Arcadis as part of the Jersey Airport Preliminary PFAS Risk Assessment (Mott Macdonald, February 2021), it is understood there are 3 separate inputs to the head of the Pont Marquet stream including the East Outfall with associated aeration pond and reedbed, a second drainage outfall from Jersey Airport and the outfall from a culvert running under Jersey Airport from St Peter's Village. It is considered important to understand the different PFAS types, concentrations and mass flux from these separate outfalls in order to fully assess the magnitude of PFAS sources to the stream and inform potential remediation / management approaches. This includes the effect of the aeration pond and reedbed;

- A potential small tributary to the stream shortly after the reedbed outfall is noted on maps but not observed during the walkover or on satellite imagery and so its presence / absence should be confirmed;
- The South Airport Outfall was reported as having the highest measured PFOS concentration within the 'PFAS and Water Quality in Jersey 2019' Interim Report by Officer Technical Group (July 2019) and it is noted that while measured PFOS concentrations within the Pont Marquet stream below the East and Southeast Outfalls are relatively low, they increase downstream of the South Outfall;
- The Pont Marquet stream is shown to be underlain by a narrow band of Alluvium overlying Jersey Shale with a small stretch overlying Granite. This indicates the stream is likely to have more limited baseflow than the streams across the St Ouen's Bay sand aquifer and may primarily be fed by rainfall runoff, springs and tributaries, especially in the upper reaches;
- There is considered to be potential for PFAS migrating via perched water and soakaways from Jersey Airport to discharge into the upper reaches of the stream, but there are no known PFAS sources further downstream in the Pont Marquet catchment. Tributaries away from the airport are considered primarily as providing dilution flow;
- While data is limited, available groundwater data does not indicate significantly elevated PFAS concentrations along the Pont Marquet stream;.
- The majority of surface water quality data has been collected from the Jersey Water abstraction within the Pont Marquet catchment, which is noted to be split from the main stream channel, thus this data is considered representative of PFAS concentrations but not total stream flow;
- An increase in PFOS concentrations was measured within the stream adjacent to St Aubin indicating the potential for additional localised PFAS sources / discharges in this area.

5 PFAS Standards Review

Arcadis have undertaken a review of the PFAS management values for waters and soils within other pertinent jurisdictions in order to provide recommendations on trigger levels for use within subsequent phases of the PFAS hydrogeological risk assessment.

PFAS standards for environmental matrices and drinking water globally have been consistently trending towards lower target values, sometimes at or below analytical detection limits, for an increasingly wider range of PFAS compounds, due to advances in the understanding of PFAS prevalence and toxicity, particularly with regards to long term exposure. Initial concern and regulatory focus has been on PFAS with longer perfluoroalkyl chains as these show greater aquatic bioaccumulation potential and have longer half-lives within the human body. However, more recently, international regulatory concerns have focussed on the shorter chain replacements and some polyfluorinated precursors.

It is noted that further changes to the standards reviewed and discussed below may occur over the course of the project and so it is recommended that an update of this section should be undertaken within Phase 2 prior to defining risk assessment scenarios and undertaking numerical modelling.

5.1 Arcadis PFAS Standards Tracker and Ranking Approach

Arcadis have built and maintain a database of global PFAS regulatory standards and thresholds, including for soils and waters, which has been leveraged to identify available standards and produce a ranked summary table. The tracker is regularly updated by regional PFAS teams within Arcadis and has been employed to identify potentially appropriate PFAS standards and guidelines within the UK as well as similar threshold values in Europe, the United States (US) and Australia which are considered relevant as having relatively robust PFAS regulatory regimes.

Accordingly, a ranked approach has been taken to review available soil and water (groundwater, surface water and drinking water) guidelines or standards based on jurisdictional suitability, status and professional judgement to shortlist these standards to those considered most likely appropriate for use within this hydrogeological study, as summarised in the table below.

Ranking	Description	Jurisdiction	Status	Date
1° Primary	Potentially suitable for use within PFAS hydrogeological study.	UK and EU Wide	Promulgated	Recent (Post 2017)
2° Secondary	Potentially suitable for use within the study depending on the exposure scenario.	National (Non-UK or EU)	Promulgated or Proposed	Recent (Post 2017) or Older
3° Tertiary	Primarily identified to provide global context and/or illustration of trends.	National (Non-UK or EU) or Regional / US State	Proposed	Recent (Post 2017) or Older

The ranked PFAS standards have then been further shortlisted to assist a review by GoJ, and represent Arcadis' current recommendations for further consideration and potential use within the hydrogeological risk assessment. Shortlisting has been undertaken based primarily on the ranking approach described above and by focussing on recent, promulgated UK and EU-wide thresholds with additional thresholds shortlisted for PFAS compounds for which would otherwise not be shortlisted.

It is also further noted that this review and subsequent recommendations are based on the ranking rationale described and professional opinion has been used to support the hydrogeological risk assessment. The final selection of PFAS standards used (in this study or elsewhere) should be made by the GoJ considering the context specific health, environmental, financial and legal costs and benefits. The PFAS standards reviewed are typically generic and may not fully reflect exposure scenarios and context relevant to Jersey and this study. The selection of standards will be further informed by the CSM, active SPR pathways identified and the results of the further monitoring and data gap assessment.

The primary, secondary and tertiary screening values identified are shown in Tables 2 to 13 with the shortlisted PFAS standards provided in Table 14.

In relation to the US jurisdiction, there are an extremely large number of US State thresholds which relate to a variety of exposure scenarios and contexts. However, as US federal thresholds are limited to PFOS and PFOA, selected US state thresholds for PFAS compounds other than PFOS and PFOA have been highlighted in order to enable a broader review of PFAS standards. The lowest promulgated threshold value for each PFAS compound has been selected in order to focus the review whilst providing a conservative illustrative of the trend towards lower threshold values.

Effluent and waste guidelines have not been reviewed at this time, however, development of trigger/action levels for soil/waste management scenarios associated with development within plume areas as well as action levels for the disposal of materials containing PFAS contaminants at licenced waste disposal sites will be undertaken as a part of Phase 2 works.

5.2 PFAS Guidelines and Standards

This section provides some additional information and commentary to support the PFAS standards reviewed and shortlisted, but it is not intended to be a comprehensive discussion of PFAS regulations globally. The focus of this section is on UK regulations with pertinent approaches from other jurisdictions also discussed.

It should be noted that PFAS guidelines and standards are changing rapidly and this report reflects the situation at the time of initial report preparation, with selected updates undertaken where considered most pertinent.

5.2.1 Surface Water

5.2.1.1 UK

PFOS is a priority hazardous substance under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. It is listed as a ubiquitous, persistent, bioaccumulative and toxic (uPBT) substance and as such, has a biota based environmental quality standard (EQS) set to protect both human health and the environment. This biota-based EQS is used for assessment of chemical status and water body classification (UK Government, 2015) and is the sum of branched and linear PFOS isomers (total PFOS). At the time of writing this is the only EQS for PFAS applicable in the UK.

An annual average (AA) EQS in water is derived by back calculation from the biota EQS. The AA EQS for PFOS is 0.00065µg/l for freshwaters. UK regulations also set out a maximum allowable concentration (MAC) for PFOS of 36µg/l for inland surface waters. The MAC is a threshold intended to protect the aquatic environment from short-term toxic effects.

These values are designed to be applied at river basin level and is a biota quality standard driven primarily by secondary poisoning of humans through consumption of fish. Significant safety factors have been incorporated into this value. Wilson (2016) reviewed the safety factors and highlighted that modification of the 0.00065 µg/l (annual average) by applying more appropriate safety factors would lead to an alternative aquatic threshold in the order of 0.130 µg/l – 0.325 µg/l (not proposed or promulgated).

The EA in 2019 (EA, 2019) used the AA-EQS as an ‘initial assessment of risk’ but also proposed an alternative water threshold for PFOS of 0.003 µg/L based on back calculating from measured PFOS concentrations in UK biota which showed equivalent results at paired (biota and surface water) monitoring locations. These alternative values have not been used for direct comparison during this report as they are not promulgated guidelines or standards, but they are referenced as they provide useful context potentially more accurately reflecting actual risk. It is understood from recent correspondence with the UK Environment Agency (EA) that chemical status classifications for PFOS in surface water are modelled (where data is not available) using the Source Apportionment Geographical Information System (SAGIS) software which uses the 0.003 µg/L.

In addition, from recent project experience Arcadis are aware that the Tier 2 (0.010 µg/L) PFOS drinking water guideline value has sometimes been referenced by the EA to guide assessment of potential PFAS discharges to surface waters where elevated background / upstream concentrations are already present. A focus is typically placed on whether any significant increases in PFAS concentrations are measured downstream

It is understood surface water EQS for additional PFAS compounds may be introduced in the UK in the near future.

5.2.1.2 Europe and the European Union

PFOS and its derivatives are also included as a priority hazardous substance under the EU Water Framework Directive (Directive 2013/39/EU), with the same annual average EQS (AA-EQS) limits as the UK at 0.00065 µg/L for in inland surface waters and 0.00013 µg/L in seawater.

Relevant promulgated surface water PFAS guidelines and standards have been identified from Germany and the Netherlands. The Predicted No Effect concentration (PNEC) values from Bavaria, Germany reflect potential risks to aquatic ecological receptors, rather than secondary poisoning by fish consumption, which is reflected in their higher values than the AA-EQS. The EQS for PFOA developed by the Dutch National Institute for Public Health and the Environment (RIVM) were developed using the same methodology as the PFOS EQS but have not been promulgated by the EU.

It is noted that the European Commission (EC) have proposed a revised EQS for PFAS in both surface water and groundwater of 0.0044 µg/l for the sum of 24 PFAS compounds where concentrations are adjusted according to a Relative Potency Factor (RPF) prior to summation (EC Proposal for a Directive amending the Water Framework Directive, the Groundwater Directive and the Environmental Quality Standards Directive, October 2022). It is understood the proposed EQS is protective of drinking water exposure routes rather than secondary poisoning by fish consumption. While this would not be applicable within the UK it provides relevant context and regulatory trajectory that may influence UK regulations in future.

5.2.1.3 United States and Australia

US Federal (Environmental Protection Agency, EPA) thresholds for PFOS and PFOA have been proposed including Criterion Continuous Concentration (CCC) and the Criterion Maximum Concentrations (CMC) based on protecting aquatic organisms from the chronic and acute, respectively, effectives of these PFAS compounds. As UK and European threshold values are available for PFOS and PFOA, these federal thresholds were not shortlisted but could be reviewed in future, particularly if and when promulgated.

Recent, promulgated US State PFAS thresholds for PFBS, PFHpA and PFNA were shortlisted despite being ranked as tertiary regional thresholds in order to provide a broader range of PFAS thresholds for consideration.

Australian surface water standards for PFOS and PFOA were reviewed but not shortlisted as UK and European thresholds were considered more relevant, however, it is noted that Australian thresholds are available for different surface water environments (from high conservation value to highly disturbed systems) which may be pertinent depending on the context. Australian thresholds are also promulgated for based on recreation water used however these were not shortlisted as were not considered likely to be relevant for surface waters within the St Ouen’s Bay and Pont Marquet catchments.

5.2.2 Drinking Water

5.2.2.1 UK

There has been increased public awareness and regulatory activity associated with PFAS in the UK over the last few years including new drinking water guidelines for PFOS and PFOA which came into effect in January 2021, and which significantly lowered the thresholds for monitoring, consultation and action to ensure the wholesomeness of supply (UK Drinking Water Inspectorate (DWI), January 2021).

The tiered approach introduced in 2021 was subsequently revised by a UK DWI Information Letter in July 2022 which is summarised below:

- **Tier 1: <0.01 µg/L**
  - continue monitoring to establish baseline;
  - ensure PFAS are considered as part of statutory risk assessment and as a hazard line with regulation 28 reports for certain risk categories;
- **Tier 2: <0.1 µg/L**
  - continue monitoring and increase frequency in tier breach predicted;
  - review control measures and risk assessments, discuss with liaison inspector if breach of internal company limit, increasing trend & to confirm if considered a reportable event;
  - Prepare control measures to prevent supply >0.1 µg/L;
  - Consult/discuss with UKHSA and local health authorities.
- **Tier 3: >0.1 µg/L**
  - Wholesomeness concentration in final water.
  - Notify UKHSA and local health authorities and as a reportable event;
  - Fast track resampling of raw and final water with sampling frequency reviewed;
  - Check and review control measures and prepare emergency contingency measures;
  - A minimum of monthly sampling in raw and treated water for 12 months;
  - Review catchment and PFAS sources information within 10 working days of receiving result and update the regulation 28 report as part of the event report.
  - All necessary actions to investigate the source of the PFAS and reduce concentrations below 0.1 µg/L in water supplied to consumers must be taken.

There are also requirements to undertake risk assessments (in accordance with Section 27 of the Water Supply Regulations) with a precautionary approach to be followed for PFAS other than PFOS and PFOA.

Subsequent Information Letters from the DWI (May 2021 and July 2022) to UK water companies provides additional guidance on monitoring, undertaking PFAS risk assessments and requires testing for 47 other PFAS compounds, which significantly broadens the range of PFAS compounds currently being monitored and assessed by UK water companies. The DWI states the tiered guidance should also be applied to any of the 47 PFAS compounds in final water (not additive) with this list subject to review. Guideline values should be applied to raw water as a precaution and so are relevant (e.g. as risk based compliance criteria) where surface water or groundwater may be used for drinking water.

The July 2022 Information Letter also requires catchment assessments are undertaken considering a minimum list of activities, listed below, and involve risk scoring linked to Low (tier 1), Medium (tier 2) and High (tier 3) risk levels.

- Airport or airfield (including landing strips), fire training centre/fire stations, major fire locations, wastewater discharges; trade effluent, industry (especially chromium plating and paper, cardboard, carpet, textile, cosmetics and food packaging manufacturing), landfills, biosolids and sludge to land.

In addition, any control measures used to manage PFAS concentrations must be scientifically proven to reduce levels of PFAS and have suitable, reliable, and regular verification processes. A PFAS sampling programme should be developed and individual raw water abstraction points should be sampled, as well as final water and submitted with monthly compliance returns. DWI risk categories (A to H) are established with a new Hazard

Code for all PFAS substances as well as individual compounds which must be included within regulation 28 reports.

5.2.2.2 Europe and the European Union

The revised EU Drinking Water Framework Directive (DWFD) came into force in January 2021 with 2 years for member states to adopt. The proposed limits are:

- 0.1µg/L for the sum of 20 individual PFAS, or
- 0.5µg/L for 'total PFAS'.

The EU commission is to assess and ensure a method for totality of PFAS is developed over next 3 years then member states can choose to use the 0.5µg/L or 0.1µg/L limit. Arcadis' current understanding is that the 0.1µg/L limit for the sum of 20 PFAS compounds is most likely to be adopted by the majority of member states. The UK Department for Environment Food and Rural Affairs (Defra) have stated they ""would consider the effect of the changes made to the directive" but have made no commitment to adopt and will likely address this within the Chemicals Strategy.

Both the UK and EU DWFD were ranked as potentially suitable for use within this study (1° Primary) as well as shortlisted in Table 14. While the thresholds are similar the key differences are that the UK approach aligns with wider UK water supply regulations, includes for the prioritising monitoring and initiating consultation as well as, based on DWI Information Letters, including assessment against the tiered guidance values for 47 PFAS compounds. The EU DWFD includes for the option to assess total PFAS, which would include more than 47 compounds (aggregated), with the sum of 20 compounds also an additive approach and thus a slightly more stringent threshold than the UK approach.

5.2.2.3 US and Australia

The current US EPA federal Health Advisory Limits (HALs) for PFOS and PFOA (0.07 µg/L sum) were not shortlisted given the availability of UK and European threshold values. However, following initial drafting of this report, the US EPA announced the proposed National Primary Drinking Water Regulation (NPDWR) for six PFAS including PFOA, PFOS, PFNA, GenX, PFHxS and PFBS which it anticipates finalising by the end of 2023. Proposed Maximum Contaminant Levels (MCLs) are 0.004µg/L for PFOS and PFOA, individually, with a Hazard Index approach for the other compounds. While these are higher than the US EPA Risk-Based Screening Levels (RSL) for drinking water, proposed in May 2022, they are an order of magnitude lower than the previous HALs and illustrate the potential direction of travel for PFAS regulatory thresholds. While many US States have adopted the HALs, many others have introduced lower drinking water thresholds in the 0.05 – 0.02 µg/L range.

5.2.3 Groundwater

5.2.3.1 UK

The potential receptors associated with groundwater contamination can include surface water features, abstractions for drinking or irrigation, for example, (as well as the groundwater being considered a receptor) and so the exposure pathway assumed by any groundwater threshold should be considered to ensure any generic thresholds are appropriate. Also, thresholds at the receptor (e.g. surface water thresholds, drinking water thresholds) are often used in place of groundwater thresholds, or used to derive site / context specific groundwater thresholds based on the receptor, the distance to the receptor and any attenuation along the pathway.

The UK Technical Advisory Group (UKTAG) on the Water Framework Directive provided a groundwater screening threshold for PFOS based concentrations in groundwater below which the danger of deterioration in the quality of the receiving groundwater is avoided. However, the threshold was derived in 2016 based on 10% of the Tolerable Daily Intake (TDI) value for PFOS at that time. While UK TDI values have not been formally modified, the 2021 DWI drinking water guidelines equates to a lower TDI value and the UK Committee on

Toxicology (COT) stated in the DWQI guidance that they would continue to evaluate the European Food Standards agency (EFSA) 2020 TDI values which are also lower than assumed within the UKTAG threshold. Therefore, while this UKTAG threshold has been shortlisted and may be suitable for screening depending on the context, the German and Swiss thresholds (discussed below) are more recent, reflect more stringent EFSA TDIs and cover a wider range of PFAS.

5.2.3.2 Europe and the European Union

While a number of PFAS thresholds are available for specific regions within certain European countries (e.g. Germany and Netherlands) national thresholds were identified for Germany and Switzerland. The German values are based on the EFSA 2018 TDIs and use a quotient based summation for 7 different PFAS compounds with individual (not additive) HALs provided for a further 7 PFAS. Switzerland has promulgated concentration limits for 9 PFAS compounds which are additive and summed based on a Toxic Equivalent (TEQ) factor.

The EC have proposed a revised EQS for PFAS in both surface water and groundwater of 0.0044 µg/l for the sum of 24 PFAS compounds as discussed in Section 5.2.1.2.

5.2.3.3 US and Australia

The proposed US EPA federal screening levels and remediation goals for PFOS and PFOA, as well as US state thresholds, were not shortlisted given the availability of UK and European threshold values but should be reviewed should any further, particularly federal, thresholds be promulgated. No promulgated PFAS thresholds in groundwater from Australia were identified.

5.2.4 Soil

5.2.4.1 UK

Soil Screening Value (SSV) have been recently derived (2022) by the UK EA for waste recovery to land based on the secondary poisoning of birds and mammals. The assumed exposure scenario reflects human health risk but does not consider potential pollution of underlying groundwater. Therefore, additional thresholds from European countries were shortlisted.

5.2.4.2 Europe and the European Union

PFAS soil thresholds from the Netherlands were shortlisted which apply to soils considered for reuse (not in-situ) reflecting a range of reuse scenarios for PFOS and PFOA. However, it is noted these criteria are generic, stringent and may not reflect actual risks in a given situation. 2022 PFAS guidelines from Germany include an approach assessing the soil to groundwater pathway whereby leachate analysis is undertaken on representative samples of unsaturated soil and compared to the groundwater thresholds contained within the 2022 guidance (also shortlisted for this study). Further, more detailed assessment or modelling of PFAS leachate attenuation may be appropriate on a site specific basis.

5.2.4.3 US and Australia

The current US EPA federal Department of Defence (DoD) RSLs for PFOS and PFOA were not shortlisted given the availability of UK and European threshold values but it is noted that US EPA RSL for protection of groundwater, residential and workers have recently (May 2022) been proposed for PFOS and PFOA which are an order of magnitude lower than the previous RSLs and illustrate the direction of travel for PFAS regulatory thresholds. These proposed US EPA RSLs could be reviewed during Phase 2 if and when they are promulgated.

6 Data Gap Assessment

For the following data review, PFOS has been used as a proxy for PFAS contamination as it known to be major component of firefighting foams used at Jersey Airport and there is significantly greater spatial and temporal data available for PFOS compared with other PFAS compounds. Prior to the use of analytical methods which quantified branched and linear forms of PFOS, concentration data for PFOS are considered equivalent to linear PFOS data as measured by more recent analysis. Therefore, the distribution and trends in groundwater and surface concentrations of linear PFOS have been reviewed in order to enable a longer term and more holistic assessment. Review of other PFAS measured within groundwater and surface water was also undertaken.

6.1 St Ouen's Bay Catchment

6.1.1 PFAS Distribution in Groundwater

The distribution of average (mean) PFOS concentrations measured in groundwater sampled from the Jersey Shale and Blown Sand between 1999 and 2021 is shown on Figure 14 and Figure 15 which is labelled with the number of data points available at each sampling location.

The distribution of average (mean) concentrations of PFHxS, 6:2 FTS, PFHxA and PFBS measured in groundwater sampled from the Jersey Shale and Blown Sand between 1999 and 2021 is shown on Figure 16 which is labelled with the number of data points available at each sampling location. Other PFAS data was available to a lesser extent and, while available within the Arcadis EsDAT database and GIS Model, is not presented visually in this report.

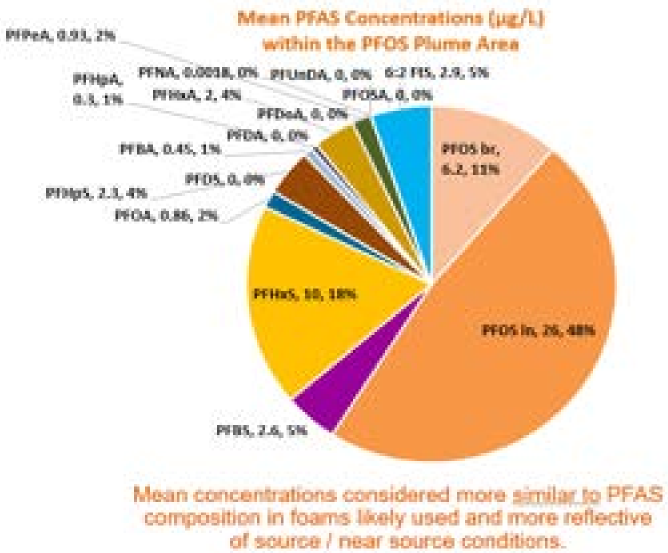
The following additional comments are made regarding PFOS distribution in groundwater:

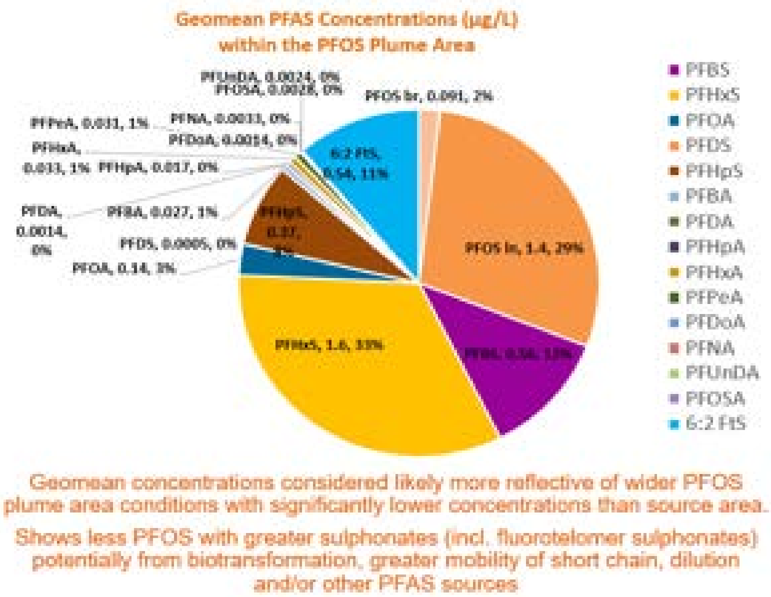
- Concentrations of PFOS in groundwater down gradient of St Peter's village but upgradient of the Mont Du Jubilee stream indicate relatively low (typically <0.01µg/L) concentrations albeit with only 1 or 2 sampling visits undertaken in this area;
- The highest average concentration of PFOS is measured in the two boreholes, FTG BH1 and FTG BH3, within the Jersey Shale located on the FTG at 73.7µg/L and 297.7µg/L, respectively. The magnitude of these concentrations indicates elevated PFAS contamination is still present in the Jersey Shale beneath the FTG. Data recorded in the Water Resources Database states the depth of pump for these wells (and therefore the assumed depth of sample collection) was similar at 50m bgl and 47m bgl and so the difference in average PFOS concentrations is inferred to relate to differences in spatial distribution of residual impacts and the fracture pathways down through the Jersey Shale;
- While an order of magnitude lower than average concentration measured in the FTG borehole, similarly elevated average PFOS concentrations (1-10 µg/L) are measured in both the Jersey Shale and Blown Sand aquifer immediately to the west of Jersey Airport near the base of the slope to the airport plateau. This aligns with the envisaged westerly groundwater flow direction and, as discussed previously (Section 4.6) indicates that PFAS migrating down from the airport plateau via the Jersey Shale enters the Blown Sands aquifer almost immediately. Variation in concentrations is also measured across relatively small distances and between aquifer geologies potentially reflecting different sampling depths and techniques but also indicating potentially complex and multiple flow paths from fractures in the Jersey Shale into the Blown Sands aquifer;
- PFOS concentrations in the Jersey Shale reduce across St Ouen's Bay while PFOS in Blown Sands remain elevated up to the coastline in some areas, indicating preferential flow within Blown Sands;
- The distribution of other PFAS compounds (Figure 16) is broadly similar to that of PFOS with the highest concentrations measured immediately to the west of Jersey Airport and decreasing across St Ouen's Bay towards the coast. Average concentrations of other PFAS are generally lower than PFOS and while datasets are available for some compounds (e.g. PFHxS and 6:2 FTS) these are still lower in number than for PFOS and are variable across the plume. Other PFAS compounds have relatively limited data available. Analysis for other PFAS is often not coherent in terms of sampling events and locations;

- Elevated average PFOS concentrations (4.15 µg/L) are measured near the southwest airport boundary in the field understood to have been used for foam spray testing (Barrack's Well, #1470); and,
- The exact sampling depths are not known which is particularly relevant at the interface of the Jersey Shale and Blown Sand aquifer. In addition, the vertical extent of the plume is not confirmed which is an important modelling parameter and relevant in the Jersey Water borehole field to understand any PFAS within the underlying shale which may be affected by changes to abstraction rates / locations. It is also possible that transport within the Jersey Shale is primarily within the upper weathered surface which could also be informed by assessment of vertical PFAS profiles in key locations.

6.1.1.1 Further Review of PFAS in Groundwater

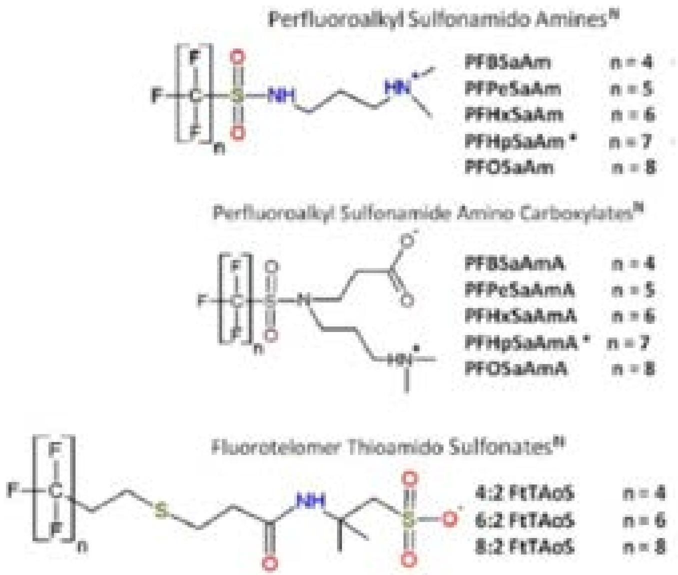
The average (geomean) groundwater and tap water sampling points between 1999 and 2021 located within the PFOS Plume Area are shown in the charts below.





Overall, the types and proportions of PFAS identified within plume area groundwater (1999-2021) appear broadly reflective of PFAS understood to be present within AFFF formulations likely used and their potential daughter products (discussed in Section 4.3.1).

3M AFFF generally contain ~20% (predominantly C6) precursors including Perfluroalkyl Sulphonamido Amines (PFASaAm) and Perfluroalkyl Sulphonamide Amino sulphonates (PFASaAmA) as shown to the right (Backe et al (2013).



The totality of these precursors have not been directly analysed or quantified to date but have the potential to biotransform within the environment to perfluoroalkyl daughter products – primarily sulphonates (PFSAs), which are commonly detected in plume area water.

6:2 Fluorotelomer Thioamido Sulphonate (6:2 FtAoS) (sometimes called TDFOXAS) has also been historically detected in plume area groundwater which can biotransform in the environment to daughter products and stable intermediates, including 6:2 FTS – which is also commonly detected in groundwater.

It is understood that C6 fluorotelomer foams were used at Jersey Airport following the Fire Training Area (FTA) redesign in 2004 but that firewater generated from this time (to present) was contained. C6 fluorotelomer foams may generate 6:2 FTS in the environment, which is detected in plume area groundwater, but there is also a potential historical source for 6:2 FTS, as discussed above, which is more likely to have been released.

6.1.2 PFAS Trends in Groundwater

Historic data transferred into the Arcadis ESDat database was reviewed in order to undertake an initial assessment of trends in PFAS concentrations within groundwater across St Ouen's Bay. The following criteria were used to focus trend assessment on suitable datasets:

- PFOS datasets were reviewed as a proxy for PFAS contamination at this stage due to the increased datasets available for PFOS;
- Datasets from locations which had been sampled on 15 or more occasions were selected;
- Datasets from locations which had been samples during or after 2015 were selected in order to ensure a relatively recent assessment of trends.

Mann Kendall statistical analysis was performed by ESDat in order to assess trends and determine whether increasing or decreasing trends were observed or whether no statistical trend could be identified. The trends in PFAS concentrations from selected wells screened within the Blown Sand and Jersey Shale aquifer are shown on Figure 17 alongside trends determined by statistical analysis. Key observations are noted below.

- Groundwater beneath the FTG showed conflicting trends with a decreasing trend identified in FTG BH3 (#61) but an increasing trend in FTG BH1 (#1468). It is noted that while an increasing trend is determined for FTG BH1 concentrations remain significantly below their peak in 2003;
- Within both the Jersey Shale and Blown Sand aquifer, in locations immediately west of the FTG, increasing trends are evident despite the historical nature of the known releases from the FTG at Jersey Airport. It is noted that some locations did not have data beyond 2015 and that significant increases in concentration were noted in some wells between 2010 and 2015 which may reflect PFAS travel times, difference in sampling or analytical techniques or that a several year period where no monitoring was undertaken affected the borehole and sample quality. The most complete long term data set from this area was obtained from CES 8 borehole (#62) which shows a spike in concentration in 2000 followed by a slow, steady increase until 2021;
- Within the centre of PFOS Plume Area, trends are mixed with both increase and decreasing trends observed within both the Jersey Shale and the Blown Sands. In particular, boreholes CES 305 (#54) and CES 306 (#55) located close together in the Blown Sands aquifer show opposing trends. The reason for this is unclear but potentially may reflect sampling depth and vertical distribution of PFAS;
- Within the St Ouen's Bay borehole field and along the coastal boundary, trends in PFOS concentrations are generally decreasing.

6.1.3 PFAS Distribution in Surface Water

The distribution of average (mean) PFOS concentrations measured in surface water sampled from the Jersey Shale and Blown Sand between 1999 and 2021 is shown on Figure 14 and Figure 18 which is labelled with the number of data points available at each sampling location.

The following additional comments are made regarding PFOS distribution in surface water:

- While average PFOS concentrations are relatively low along the Mont du Jubilee stream (0.2µg/L to 0.7µg/L) they are still elevated with respect to typical background surface water concentrations and therefore do indicate some PFAS inputs which, given the low PFOS concentrations which have been measured in nearby groundwater, are considered likely to come from drainage outfalls, perched water and surface water runoff from Jersey Airport;

- Average PFOS concentrations increase across the associated network of streams and surface water features when the Mont Du Jubilee stream reaches the Blown Sand Aquifer in St Ouen's Bay indicating continuity with groundwater & potential PFAS ingress into surface water;
- The highest concentrations measured in surface water (5.4µg/L to 73µg/L) are measured in the small springs and discontinuous features immediately west of Jersey Airport and the base of the slope to the airport plateau; and
- Elevated PFOS concentrations are also measured within Simon Sandpit and other surface water features across St Ouen's Bay, with elevated groundwater concentrations hydraulically down gradient of these features compared with similar, adjacent locations within the plume. This indicates that Simon Sandpit and other surface water features may be influencing (facilitating) groundwater flow and hence PFOS migration although this is likely to be variable seasonally depending on surrounding groundwater elevations, further assessment would be required to confirm e.g. assessing any flow within the ponds.

6.1.4 PFAS Trends in Surface Water

As more limited PFAS concentration data was available for surface water, locations were selected for trend analysis where greater than 10 data points were available. The trends graphs are shown on Figure 19 alongside trends determined by statistical analysis. Key observations are provided below.

- Limited recent surface water quality data was available with no data available after 2013. This is considered a significant data gap in relation to long term and seasonal trends in PFAS migration via surface waters;
- No increasing trends were observed with either decreasing trends or 'no trends' determined by Mann Kendall statistical analysis. Where no statistically significant increasing or decreasing trends are identified via Mann Kendall analysis, the output is stated as 'no trend'.

6.1.5 PFAS in Biota

The available biota data for species sampled from St Ouen's Bay is presented in Table 15.

- Analysis of PFOS, 6:2 FTS, 6:2 FtSO2AoS, 6:2 FtSOAoS, PFBS, PFOA and PFPeS have been undertaken on samples of Common Limpet (2007) and Seaweed Fucus (2007 and 2012) from St Ouen's Bay. The results for all compounds on all occasions were below the analytical limits of detection (between 0.01 µg/L for PFOS up to 0.58µg/L for other PFAS);
- Available groundwater trend data from wells located along the St Ouen's Bay coastline indicate generally decreasing trends and so there is no reason to suspect that PFAS concentrations in these biota species would have increased since 2007 and 2012;
- Arcadis have not undertaken a review to confirm whether the Common Limpet and Fucus species are representative of the most sensitive or most significant potential exposure pathways associated with biota in St Ouen's Bay or if sampling of additional species would be warranted. This is considered a minor data gap for further discussion;
- It is assumed that there is limited consumption of fish or other species from inland surface waters across St Ouen's Bay;
- Sampling and analysis of potatoes collected from fields in St Ouen's Bay, in the vicinity of Jersey Airport have been reported in 1998 (CES,973422/JHA3, 1998) and 2000 (Harbours and Airports Committee, JHA 87, 2000). In the 1998 assessment, 17 samples of potatoes were collected and extracted by boiling with the concentration of sum 'fluorinated surfactants' quantified relative to sample of AFFF foam concentration at <10ppb. It is noted that butyl carbitol which is a common ingredient within many firefighting foam formulations was detected in approximately 50% of samples. The 2000 assessment was undertaken to confirm the results of previous assessments using a modified sample clean-up and extraction procedure and measuring specific PFAS compounds. The analysis (undertaken by M-Scan) also found that none of the potatoes cooking

waters or aqueous flesh extracts showed any positive Electrospray Mass-Spectroscopy (ESMS) evidence for PFHS (assumed to be PFHxS) or PFOS, with limits of detection at 10ppb (20ppb in cooking water);

- Different PFAS can accumulate within different crops depending on their chain length, functionality and crop type with irrigation by contaminated groundwater likely a key pathway given the absence of large volumes of biosolids application. Further review is recommended to assess any other relevant food crops and determine whether more sensitive analytical testing is available for a wider range of PFAS and whether further sampling and analysis of crop biota would be justified.

6.1.6 Summary of Data Gaps

Figures 20 and 21 show areas of identified data gaps in relation to the distribution of PFAS in groundwater and surface water, respectively, across St Ouen's Bay.

The table below summarises the data gaps with respect to PFAS distribution, trends and other data identified following review of available data.

Dataset	Data Gap Description
Spatial Distribution of PFAS in Groundwater	• No PFAS data from the Blown Sand or Jersey Shale immediately southwest of airport potentially down gradient of light aircraft crash and foam spillage (2005); • No PFAS data from the Blown Sand via a potential surface water pathway into St Ouen's borehole field southwest of the airport; • No PFAS data from the Jersey Shale beneath the St Ouen's borehole field; • Multiple PFOS datasets from Blown Sand and Jersey Shale immediately west of airport and along the coastal discharge boundary. Minor gaps in coverage and number of analyses for PFOS across plume area but sufficient boreholes present to address; • While datasets are available for PFHxS and 6:2 FTS, analysis of PFAS precursors and other PFAS compounds is generally limited and often not coherent in terms of sampling events and locations; • Limited data is available for PFAS within shallow perched groundwater across the airport and the potential for this to discharge into nearby surface water features. • The exact sampling depths are not known which is particularly relevant at the interface of the Jersey Shale and Blown Sand aquifers. In addition, the vertical extent of the plume is not confirmed which is an important modelling parameter and relevant in the Jersey Water borehole field to understand whether any PFAS within the underlying shale may have been affected by changes to abstraction rates / locations. It is also possible that transport within the Jersey Shale is primarily within the upper weathered surface which could also be informed by assessment of vertical PFAS profiles in key locations; • Partitioning coefficients used in modelling to estimate the distribution of PFAS between soil and groundwater are only available for some PFAS compounds and for generic soil types. Assessment of site specific PFAS partitioning values would increase the accuracy of fate and transport modelling;
Temporal Trends in PFAS in Groundwater	• Limited number of analyses in groundwater down gradient of St Peter's village and Cessna crash; • While datasets are available for PFOS in certain locations, and to a lesser extent PFHxS and 6:2 FTS, available trend data for PFAS precursors and other PFAS are currently limited; • While long term trends for PFOS and some other PFAS are available, seasonal trends have not been described; • Several wells within the PFOS Plume Area, including immediately down gradient of the FTG and along the coastal boundary, have no data available after 2015; • Confirmation of sampling depth and other factors would be useful to further interpret trends, particularly where opposing trends are observed in nearby locations.
Spatial Distribution of PFAS in Surface Water	• Limited longer term / seasonal datasets for PFAS concentration in the upper reaches of the Mont Du Jubilee stream and stream to the south of the Airport associated with South Southwest Outfall; • No data sets from several small surface water features across St Ouen's Bay; • Analysis of PFAS precursors and other PFAS compounds is generally limited; • PFAS concentration data from drainage outfalls is generally limited in terms of types of PFAS tested and number of datasets over time.
Temporal Trends in PFAS in Surface Water	• No data is available for surface water after 2013 indicating data gaps regarding current surface quality and trends; • While long term trends for PFOS and some other PFAS are available, seasonal trends have not been described.

Dataset	Data Gap Description
Biota	• Further review is recommended to assess any other relevant marine biota species or food crops and determine whether more sensitive analytical testing is available for a wider range of PFAS and whether further sampling and analysis of biota would be justified.
Location Data	• Well construction details and depth to base of well are not available in the majority of locations; • Groundwater sampling depth typically not known / available.
Hydrogeology	• Interaction and connectivity between the Jersey Shale and the Blown Sand aquifer, as well as the interaction between groundwater and surface water across St Ouen's Bay, would benefit from further assessment; • Groundwater elevations available regionally but limited well specific data to inform localised groundwater flow direction, PFAS transport and interaction between groundwater, surface water and aquifers; • Surface water elevations collected at the same time at groundwater elevations are currently limited; • Some hydraulic conductivity data is available from previous reports but unless further information from the Blown Sand aquifer is available from Jersey Water then additional pump test / rising head test data would be valuable; • Surface water and drainage outfall flow rate & discharge data is generally limited and would be valuable to inform mass flux of PFAS from outfalls and across the surface water catchments, especially to inform seasonal trends.

6.2 Pont Marquet Catchment

6.2.1 PFAS Distribution in Groundwater

The distribution of average (mean) PFOS concentrations measured in groundwater sampled from the Jersey Shale between 1999 and 2021 is shown on Figure 22 and Figure 23 which is labelled with the number of data points available at each sampling location.

The following additional comments are made regarding PFOS distribution in groundwater:

- Elevated PFOS concentrations (1.1 to 1.2 µg/L) have been measured on Jersey Airport (in the Jersey Shale) within the Southeast drainage catchment (near the site boundary) at the Europcar Borehole #1981. It is not clear whether these detections relate to firefighting foam use or other potential sources (e.g. car waxes, polishes) but the location is approximately 150m from the Pont Marquet stream and indicates a potential pathway to the stream via groundwater and/or perched water. It is noted that a PFOS concentration of 0.004µg/L was measured in the Jersey Shale adjacent to the stream in this area, however, this is located on the other side of the stream to Jersey Airport and so may not fully capture potential discharges via groundwater from the airport direction;
- Average concentrations of PFOS in groundwater in the Jersey Shale to the west of Pont Marquet stream, including potentially down gradient of the JAFF soakaway, are between 0.175µg/L and 0.06µg/L which are slightly elevated compared to other locations across the Pont Marquet catchment, indicating some potential for PFAS input from groundwater to stream in this area – albeit potentially minor;
- Average concentrations of PFOS in groundwater immediately down gradient of the eastern end of Jersey Airport as well as to the east of Pont Marquet stream are low (<0.007µg/L) indicating limited potential PFAS migration and input from groundwater to the stream in these areas;
- There are no major data gaps regarding spatial coverage of groundwater locations for PFOS across the Pont Marquet catchment, however, while one location near La Rue des Mans was sampled for other PFAS (on one occasion) no testing for other PFAS in groundwater along Pont Marquet catchment has been undertaken.

6.2.2 PFAS Trends in Groundwater

- PFOS and other PFAS data has been collected on one or two occasions across the Pont Marquet catchment and therefore assessment of PFAS concentration trends is not currently possible.

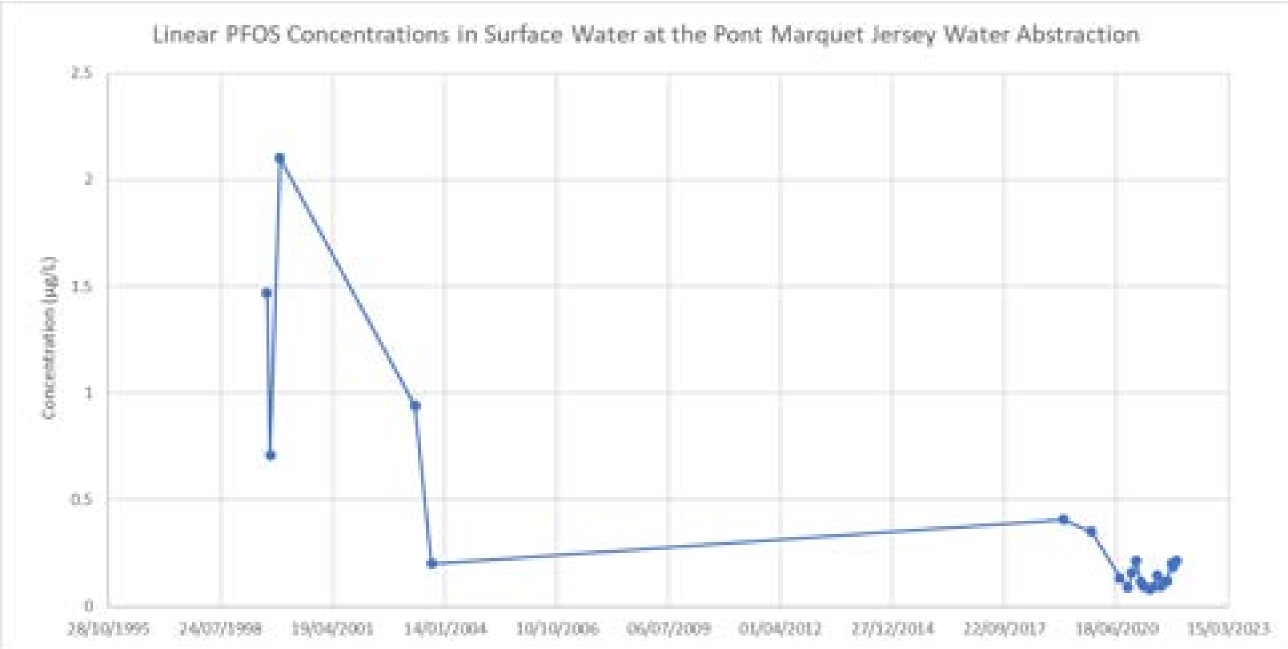
6.2.3 PFAS Distribution in Surface Water

The distribution of average (mean) PFOS concentrations measured in surface water sampled from the Jersey Shale between 1999 and 2021 is shown on Figure 22 and Figure 24 which is labelled with the number of data points available at each sampling location.

- The South Airport Outfall has the highest measured PFOS concentration (2.62µg/L) and it is noted that while measured PFOS concentrations within the Pont Marquet stream below the East and Southeast Outfalls are relatively low (although above expected background concentrations), they increase notably downstream of the South Outfall (from 0.175µg/L to 0.488µg/L);
- There are three separate inputs to the head of the Pont Marquet stream including the East Outfall with associated aeration pond and reedbed, a second drainage outfall from Jersey Airport and the outfall from a culvert running under Jersey Airport from St Peter's Village. Currently available data includes sampling of the second drainage outfall from Jersey Airport (3 occasions) where the average concentration of PFOS (0.62µg/L) was an order of magnitude higher than the average concentration measured in the culvert outfall (0.04µg/L, sampled on 2 occasions). This East Outfall directly before and after the aeration pond and the reedbed has not been sampled. It is considered important to understand the different PFAS types, concentrations and mass flux from these separate outfalls in order to fully assess the magnitude PFAS sources to the stream and inform potential remediation / management approaches. This includes the effect of the aeration pond and reedbed;
- There is no sampling of the stream to include the combined flow of the three outfalls associated with the East Outfall area until below the Southeast Outfall (0.175µg/L) thus it is not possible to fully understand the magnitude of inputs associated with the Southeast Outfall;
- Multiple samples (22) have been taken from the Jersey Water abstraction point on the Pont Marquet stream with a max of 2.1µg/L and an average of 0.37µg/L measured between 1999-2021. The channel where the abstraction point is located is split from the main stream channel, thus it is considered representative of PFAS concentrations but not total stream flow;
- While multiple samples have been taken from the Jersey Water abstraction for other PFAS, other locations along Pont Marquet stream have only previously been tested for PFOS. The average concentrations of PFHxS, 6:2 FTS, PFBS and PFHxA (compounds selected for illustration) at the abstraction point were an order of magnitude lower than PFOS at 0.075, 0.016, 0.078 and 0.03 µg/L, respectively. The maximum concentrations were all below 1µg/L with the exception of PFBS which had a maximum of 1.24 µg/L;
- An increase in PFOS concentrations was measured within the stream adjacent to St Aubin indicating the potential for additional localised PFAS sources / discharges in this area. The average PFOS concentration was 1.02 µg/L with a maximum of 3.6µg/L.

6.2.4 PFAS Trends in Surface Water

The only surface water sampling location with sufficient data points (22) to assess trends in PFOS concentration is the Jersey Water abstraction (#727) for which the trend data is shown below.



- An overall decreasing trend was determined by Mann Kendall statistical analysis with the highest concentration of 2.1µg/L measured in 2000 decreasing to between 0.08µg/L and 0.213µg/L across multiple sampling visits undertaken in 2021. Some seasonality in PFOS concentrations is apparent with peaks in concentrations observed within winter months, although the dataset is still somewhat limited.

6.2.5 PFAS in Biota

The available biota data for species sampled from St Aubin's Bay is presented in Table 15.

- Analysis of PFOS, 6:2 FTS, 6:2 FtSO2AoS, 6:2 FtSOAoS, PFBS, PFOA and PFPeS have been undertaken on samples of Common Limpet (2007), Slipper Limpet (2007) and Seaweed Fucus (2007 and 2011) from St Aubin's Bay. The results for all compounds on all occasions were below the analytical limits of detection (between 0.01µg/L for PFOS up to 0.58µg/L for other PFAS);
- Available surface water trend data from the Jersey Water abstraction located on the Pont Marquet stream indicate generally decreasing trends and so there is no reason to suspect that PFAS concentrations in these biota species would have increased since 2007 and 2011;
- Arcadis have not undertaken a review to confirm whether the Common Limpet, Slipper Limpet and Fucus species are representative of the most sensitive or most significant potential exposure pathways associated with biota in St Aubin's Bay or if sampling of additional species would be warranted. This is considered a minor data gap for further discussion;
- It is assumed that there is limited consumption of fish or other species from the Pont Marquet stream.

6.2.6 Summary of Data Gaps

Figure 25 shows areas of identified data gaps in relation to the distribution of PFOS in surface water, respectively, across Pont Marquet.

The table below summarised the data gaps with respect to PFAS distribution, trends and other data identified following review of available data.

Dataset	Data Gap Description
Spatial Distribution of PFAS in Groundwater	• There are no major data gaps regarding spatial coverage of groundwater locations for PFOS across the Pont Marquet catchment, however, while one location near La Rue des Mans was sampled for other PFAS (on one occasion) no testing for other PFAS in groundwater along Pont Marquet catchment has been undertaken.
Temporal Trends in PFAS in Groundwater	• PFOS and other PFAS data has been collected on one or two occasions across the Pont Marquet catchment and therefore assessment of PFAS concentration trends is considered a key data gap.
Spatial Distribution of PFAS in Surface Water	• It is considered important to understand the different PFAS types, concentrations and mass flux from these separate outfalls in order to fully assess the magnitude of PFAS sources to the stream and inform potential remediation / management approaches. This includes the effect of the aeration pond and reedbed; • There is no sampling of the stream to include the combined flow of the 3 outfalls associated with the East Outfall area until below the Southeast Outfall (0.175µg/L) thus it is not possible to fully understand the magnitude of inputs associated with the Southeast Outfall; • While multiple samples have been taken from the Jersey Water abstraction for other PFAS, other locations along Pont Marquet stream have only previously been tested for PFOS. • An increase in PFOS concentrations was measured within the stream adjacent to St Aubin indicating the potential for additional localised PFAS sources / discharges in this area. It is proposed to confirm this observation during Phase 2 but further assessment of potential sources around St Aubin would require a separate study.
Temporal Trends in PFAS in Surface Water	• The only surface water sampling location with sufficient data points to assess trends is the Jersey Water abstraction; • In all other locations, including outfalls, there is no available long term seasonal trend data for PFOS or other PFAS.
Biota	• Further review is recommended to assess any other relevant marine biota species and determine whether more sensitive analytical testing is available for a wider range of PFAS and whether further sampling and analysis of biota would be justified.
Location Data	• Well construction details and depth to base of well are not available in the majority of locations; • Groundwater sampling depth typically not known / available.
Hydrogeology	• Interaction and connectivity between groundwater in the Jersey Shale and surface water along the Pont Marquet catchment would benefit from further assessment; • Groundwater elevations available regionally but limited well specific data to inform localised groundwater flow direction, PFAS transport and interaction between groundwater and surface water; • Surface water elevations collected at the same time at groundwater elevations are currently limited; • Surface water and drainage outfall flow rate & discharge data is generally limited and would be valuable to inform mass flux of PFAS from outfalls and across the surface water catchments especially to inform seasonal trends.

7 Scope for Further Assessment

The findings from the data visualisation, initial CSM development and data gaps assessment have been used to inform a proposed scope of further assessment for the St Ouen's Bay and upper Pont Marquet catchments. The further assessment works are intended to be undertaken as part of Phase 2 of this PFAS hydrogeological study and risk assessment.

The proposed scope of further assessment is currently being reviewed and discussed with GoJ, amended as appropriate, prior to tendering and procurement.

8 References and Links

BGS – Solid and Drift Geology of Jersey

https://webapps.bgs.ac.uk/data/maps/maps.cfc?method=viewRecord&mapId=11287

BGS – hydrogeology of Jersey

https://webapps.bgs.ac.uk/data/maps/maps.cfc?method=viewRecord&mapId=11570

Government of Jersey – Jersey water pollution risk map

https://statesofjersey.maps.arcgis.com/apps/webappviewer/index.html?id=08c3015f8e8e4a3c961701390d3c2d29

Government of Jersey States Reports – Challenges for the water environment of Jersey

https://www.gov.je/government/pages/statesreports.aspx?reportid=1123

Government of Jersey Blog – Jersey's Sites of Special Interest

https://blog.gov.je/2018/02/06/jerseys-sites-special-interest/

Jersey Water – PFAS

https://www.jerseywater.je/pfas/

Jersey Water – Water Quality Reports

https://www.jerseywater.je/water-quality-report/

Jersey Water – Water Resources and Drought Management report and technical appendices

https://www.jerseywater.je/water-resources/

GIS Data Sources

Jersey Water ArcGIS public data sources

https://services2.arcgis.com/6yKgPVaFxpa5p7tT/ArcGIS/rest/services/

Government of Jersey ArcGIS public data sources

https://services6.arcgis.com/2V6UBtY4hQyxLsAp/ArcGIS/rest/services/

Appendix A

Study Limitations

IMPORTANT. This appendix should be read before reliance is placed on any of the information, opinions, advice, recommendations or conclusions contained in this report.

1 This report has been prepared by Arcadis Consulting (UK) Limited ('Arcadis'), with all reasonable skill, care and diligence within the terms of the Appointment and with the resources and manpower agreed with Government of Jersey (the 'Client'). Arcadis does not accept responsibility for any matters outside the agreed scope.

2 This report has been prepared for the sole benefit of the Client unless agreed otherwise in writing. The contents of this report may not be used or relied upon by any person other than this party without the express written consent and authorisation of Arcadis.

3 Unless stated otherwise, no consultations with authorities or funders or other interested third parties have been carried out. Arcadis is unable to give categorical assurance that the findings will be accepted by these third parties as such bodies may have unpublished, more stringent objectives. Further work may be required by these parties.

4 All work carried out in preparing this report has used, and is based on, Arcadis' professional knowledge and understanding of current relevant legislation. Changes in legislation or regulatory guidance may cause the opinion or advice contained in this report to become inappropriate or incorrect. In giving opinions and advice, pending changes in legislation, of which Arcadis is aware, have been considered. Following delivery of the report, Arcadis has no obligation to advise the Client or any other party of such changes or their repercussions.

5 This report is only valid when used in its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report.

6 Whilst this report and the opinions made are correct to the best of Arcadis' belief, Arcadis cannot guarantee the accuracy or completeness of any information provided by third parties. provided by third parties. Arcadis has taken reasonable steps to ensure that the information sources used for this assessment provided accurate information and has therefore assumed this to be the case.

7 This report has been prepared based on the information reasonably available during the project programme. All information relevant to the scope may not have been received.

8 This report refers, within the limitations stated, to the condition of the Site at the time of the inspection. No warranty is given as to the possibility of changes in the condition of the Site since the time of the investigation.

9 The content of this report represents the professional opinion of experienced environmental consultants. Arcadis does not provide specialist legal or other professional advice. The advice of other professionals may be required.

10 Where intrusive investigation techniques have been employed they have been designed to provide a reasonable level of assurance on the conditions. Given the discrete nature of sampling, no investigation technique is capable of identifying all conditions present in all areas. In some cases the investigation is further limited by Site operations, underground obstructions and above ground structures. Unless otherwise stated, areas beyond the boundary of the Site have not been investigated.

11 If below ground intrusive investigations have been conducted as part of the scope, safe location of exploratory holes has been carried out with reference to the Arcadis ground disturbances procedure. No guarantee can be given that all services have been identified. Additional services, structures or other below ground obstructions, not indicated on the drawing, may be present on Site.

12 Unless otherwise stated the report provides no comment on the nature of building materials, operational integrity of the facility or on any regulatory compliance issues.

13 Unless otherwise stated, an inspection of the Site has not been undertaken and there may be conditions present at the Site which have not been identified within the scope of this assessment.

14 Unless otherwise stated, samples from the Site (soil, groundwater, building fabric or other samples) have not been obtained.

15 Arcadis has relied upon the accuracy of documents, oral information and other material and information provided by the Client and others, and Arcadis assumes no liability for the accuracy of such data, although in the event of apparent conflicts in information, Arcadis would highlight this and seek to resolve.

16 Unless otherwise stated, the scope of works has not included an environmental compliance review, health and safety compliance review, hazardous building materials assessment, interviews or contacting Local Authority, requests for information to the petroleum officer, sampling or analyses of soil, ground water, surface water, air or hazardous building materials or a chain of title review.

17 Unless otherwise stated, this assessment has considered the ongoing use of the Site and has not been prepared for the purposes of redevelopment which may act as a trigger for Site investigation and remediation works not needed for ongoing use.

Appendix B

Third Party Reports

Appendix B - PFAS related reports provided by GoJ as part of study documents.

Report file name	Report Date	JHA report/reference number	Reporting Company
Nicholas & Nunn 1974 - Sand Resources of St Ouen's - Borehole Logs and Test results	Jan-74		Nicolas and Nunn
Development of St Ouen's Bay Aquifer	Sep-79		Rofe, Kennard & Lapworth
EPR-R-1991-01-01 Hydrogeological and Hydrogeochemical survey of Jersey	Jan-91		British Geological Survey
EPR-R-1994-09 Preliminary Groundwater Investigation	Sep-94		CES
Follow Up Groundwater Pollution Investigation Feb 1995	Feb-95		CES
Follow Up Groundwater Pollution Investigation May 1995	May-95		CES
EPR-R-1995-10 Airport CES 7 Groundwater Investigation	Oct-95		CES
EPR-R-1995-10 Airport CES 12 Groundwater Investigation	Oct-95		CES
EPR-R-1995-10 Airport CES 52 Groundwater Investigation	Oct-95		CES
Follow Up Groundwater Contamination Investigation	Oct-95		CES
EPR-R-1997-01 Refuelling Plant Groundwater Assessment	Jan-97		Rust Environmental
Airport Groundwater Contamination Event Summary 1997 draft	Nov-97		CES
Groundwater Contamination Event Summary up to Nov 1997	Mar-98		CES
Laboratory and Sampling Reports - 1998 Jersey Potato Crop	Nov-98	JHA003	CES
Fluorinated Protein Foams correspondence	Jan-99	JHA030	CES
Summary of Airport FTG Contamination Investigation	Mar-99	JHA015	CES
1999-07 Harbours & Airports Presidents Briefing Notes	Jul-99	JHA024a,b,c,d,e,25, 26, 27 (tables from 31)	Harbours and Airports Presidents Briefing Notes
FTG Ecotoxicological Information	Jul-99	JHA038	CES
FTG Investigation analysis results	Jul-99	JHA026	Harbours and Airports Presidents Briefing Notes
Papers JHA24a-26 briefing notes	Jul-99	JHA024a,b,c,d,e,25, 26, 27 (tables from 31)	Harbours and Airports Presidents Briefing Notes
St Ouen's Aquifer investigation reports & new information	Jul-99	JHA041	CES
Groundwater Contamination Chronology of Events draft	Sep-99	JHA057	CES
AFFF Analysis correspondence	Nov-99		Water and Effluent Treatment Ltd
AFFF Calibration & Validation briefing note	Jan-00	JHA072	Harbours and Airports Committee
EPR-R-2000-01 Groundwater Contamination Chronology	Jan-00	JHA066	CES
EPR-R-2000-01 St Ouen's Bay Public Supply Boreholes	Jan-00	JHA034	CES
Fluorinated Surfactants Examination briefing note	Jan-00	JHA075	Harbours and Airports Committee
January 2000 Monitoring Programme briefing note	Jan-00	JHA071	Harbours and Airports Committee
Restoration of St Ouen's Well Field briefing note	Jan-00	JHA067	CES
St Ouen's Aquifer - G & H Assessment V1 text	Jan-00		CES
St Ouen's Aquifer - G & H Assessment V2 figures and appendices	Jan-00		CES
St Ouen's Bay Monitoring Scheme 1st Quarter Final Report	Jun-00	JHA083	CES
Water Quality Impact Assessment from Fire Fighting	Jun-00	JHA068	CES
St Ouen's Potato Crop Examination briefing note	Jul-00	JHA087	Harbours and Airports Committee
2nd Quarter Monitoring Report for St Ouen's Bay	Aug-00	JHA090	CES
Requirements from 3M JHA92	Aug-00	JHA092	CES
Data Using Primary Standard Material JHA 99	Nov-00	JHA099	Harbours and Airports Committee
EPR-R-2000-11 Foam Runoff Tests	Nov-00		CES
St Ouen's Bay 3rd Quarter Monitoring Report	Nov-00	JHA095	CES
EPR-R-2001-01 Foam Runoff Tests Conclusions	Jan-01		CES
St Ouen's Aquifer - Geological and Hydrogeological Assessment	Jan-01	JHA104	CES
4th Quarter Monitoring Report for St Ouen's Bay	Feb-01	JAH106	CES
5th Monitoring Report for St Ouen's Bay	Jul-01	JHA122	CES
FTA Secondary Investigation	Jul-01	JHA121	CES
Historical Hydrocarbons Examination at Elm Farm	Jul-01	JHA128	Harbours and Airports Committee
3M & M-Scan results for PFOS	Sep-01	JHA136	Harbours and Airports Committee
Drainage Strategy Group AFFF & FFFP Modelling	Sep-01	JHA139	Drainage Strategy Group
PFOS in St Ouen's Bay	Oct-01	JHA135	CES
EPR-R-2002 Airport FTG Supplementary Ground Investigation	Jan-02		Faber Maunsell
2002-02 Harbours & Airports Committee Briefing Notes	Feb-02	JHA147	Harbours and Airports Committee
FTG Drain Outfall Supplementary Soil Investigation	Apr-02	JHA149	Marquis & Lord Consulting Scientists
FTG Pumping Trial briefing note	Apr-02	JHA150	Marquis & Lord Consulting Scientists
Jersey Airport Drainage Strategy 2002	Jun-02		Penny Anderson Associates
6th Monitoring Report & Water Quality Impact Assessment of Fire Training	Jul-02	JHA159	Metcalf & Eddy Ltd (AECOM)
EPR-R-2002-07 Airport FTG Pumping Trials Review	Jul-02		WRc
St Ouen's Bay 7th Monitoring Report	Sep-02	JHA160	Faber Maunsell
St Ouen's Bay 8th Monitoring Report	Jun-03	JHA169	Faber Maunsell
10th Monitoring Report at St Ouen's Bay	Apr-04	JHA173	Faber Maunsell
EPR-R-2004-04-02 Shellfish Analysis	Apr-04		Marquis & Lord Consulting Scientists
11th Monitoring Report at St Ouen's Bay	Nov-04	JHA178	Faber Maunsell
Airport Aeration Pond Fluorosurfactant Residues sample analysis	Nov-04		Marquis & Lord Consulting Scientists
Fire Tender Crash Results email	Dec-04		Jersey Airport
St Ouen's Bay Monitoring Report 2005	Mar-06		Faber Maunsell (AECOM
Boreholes A1 & A5 sample analysis	Jul-09	JHA039 JHA040	CES
EPR-R-2009-10 St Ouen's Bay Monitoring Review	Oct-09	JHA225	AECOM
EPR-R-2014-04-17 Hydrogeological and hydrogeochemical survey of Jersey Notes			BGS

Appendix B - PFAS related reports provided by GoJ as part of study documents.

Report file name	Report Date	JHA report/ reference number	Reporting Company	comments
FISH				
Xchem18K CoA	Jun-18		CEFAS Laboratory	Analysis of Carp muscle and liver from one fish
MILK & POTATO				
Vista Method Summary			VISTA	method for milk analysis
Vista Results	Jun-19		VISTA	Analysis report
Potato & milk sample locations & details - PFOS.xlsx				Details of locations for samples
ShellFish				
EPR-R-2007-12-01 Briefing Number JA218 Shellfish Monitoring Sep-Oct 2007		JHA218	Marquis & Lord	summary report for analysis of shellfish and seaweed.
EPR-R-2009-10-13 Firefighting foam water analysis in Shellfish - Report No 0910-21133	Oct-09		SGS M-SCAN Ltd	Analysis report
EPR-R-2010-10-28 Firefighting foam water analysis in Shellfish - Report No 1010-21886	Oct-10		SGS M-SCAN Ltd	Analysis report
EPR-R-2012-06-23 Firefighting foam water analysis in Shellfish - Report No 1206-23222	Jun-12		SGS M-SCAN Ltd	Analysis report
EPR-R-2012-11-21 Firefighting foam water analysis in Shellfish - Report No 1211-23534	Nov-12		SGS M-SCAN Ltd	Analysis report
Light Aircraft Crash Reports				
Crash site - Site plan	Oct-04			Hand annotatd plan showing crash site and flow of water
Interpretation of water quality post air accident	Nov-04		Environment Dept	Environment dept briefing note- water quality post air accident
Petroseal data sheet			Angus Fire	Petroseal data sheet
Petroseal material safety data sheet			Angus Fire	Petroseal 3% Materail Safety Data Sheet
pollution report	Oct-04		POLREP database	Pollution incident report incident log
Second review of water quality post air accident	Feb-05		Environment Dept	Second review of water quality post air accident
Laboratory Certs				
EP-R PFOS property results 1999 - 2016 21.02.2017				summary of property in plume PFAS analsys results
EPR-R-2006-12-06 Firefighting foam water analysis	2006			table of data from 2006
EPR-R-2007-07-31 Firefighting foam water analysis - Report No 0707-19298	Jul-07		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2008-01-09 Firefighting foam water analysis - Report No 0802-19790	Jan-08		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2009-01-19 Firefighting foam water analysis - Report No 0901-20486	Jan-09		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2009-01-29 Firefighting foam water analysis - Report No 0901-20486-2	Jan-09		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2009-01-29 Firefighting foam water analysis extra - Report No 0901-20528	Jan-09		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2009-03-30 Firefighting foam water analysis - Report No 0903-20637	Mar-09		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2009-07-27 Firefighting foam water analysis - Report No 0907-20973	Jul-09		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2010-02-12 Firefighting foam water analysis - Report No 1003-21415	Feb-10		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2010-03-12 Firefighting foam water analysis - Report No 1003-21414	Mar-10		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2010-06-21 Firefighting foam water analysis - Report No 1006-21704	Jun-10		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2011-03-22 Firefighting foam water analysis - Report No 1103-22315	Mar-11		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2011-10-21 Firefighting foam water analysis - Report No 1110-22756	Oct-11		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2012-02-21 Firefighting foam water analysis - Report No 1202-22923	Feb-12		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2012-04-20 Firefighting foam water analysis - Report No 1204-23163	Apr-12		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2012-10-19 Firefighting foam water analysis - Report No 1210-23533	Oct-12		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2013-06-21 Firefighting foam water analysis - Report No 1305-24029	Jun-13		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2014-07-15 Firefighting foam water analysis - Report No 1407-24718	Jul-14		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2015-07-23 Firefighting foam water analysis - Report No 073-000-001	Jul-15		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2015-10-20 Firefighting foam water analysis - Report No 073-000-003	Oct-15		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-02-24 Firefighting foam water analysis - Report No 073-000-004	Feb-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-03-14 Firefighting foam water analysis - Report No 073-000-005	Mar-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-03-21 Firefighting foam water analysis - Report No 073-000-006	Mar-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-04-22 Firefighting foam water analysis - Report No 073-000-007	Apr-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-05-12 Firefighting foam water analysis - Report No 073-000-008	May-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-05-27 Firefighting Foam water analysis - Report No 073-000-009	May-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-07-21 Firefighting foam water analysis - Report No 073-000-010	Jul-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-07-21 Firefighting foam water analysis - Report No 073-000-011	Jul-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-07-27 Firefighting foam water analysis - Report No 073-000-010v2	Jul-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-07-27 Firefighting foam water analysis - Report No 073-000-010v3	Jul-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-07-27 Firefighting foam water analysis - Report No 073-000-011v2	Jul-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-09-09 Firefighting foam water analysis - Report No 073-000-002	Sep-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-09-21 Firefighting foam water analysis - Report No 073-000-012	Sep-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-12-14 Firefighting foam water analysis - Report No 073-001-001	Dec-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS
EPR-R-2016-12-21 Firefighting foam water analysis - Report No 073-002-001	Dec-16		SGS M-SCAN Ltd	Laboratory analysis for PFAS

Appendix C

Figure 25 - Spatial Data Gaps for PFOS in Surface Water – Pont Marquet Catchment

LEGEND

MAIN STUDY AREA

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE:

STUDY AREA LOCATION PLAN

SITE : **JERSEY**

CLIENT : **STATES OF JERSEY**

PROJECT :	**10050570**	**FIGURE 1**	
DATE :	30/08/22	DRAWN BY :	JS
DRG No. :			
SCALE :	1:65,000	PRINT :	A3

ARCADIS

EUROPEAN SPACE AGENCY - ESA

LEGEND

STUDY AREA

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE:

STUDY AREA LOCATION PLAN

SITE : **JERSEY**

CLIENT : **STATES OF JERSEY**

PROJECT : **10050570**	**FIGURE 2**
DATE : 30/08/22	DRAWN BY : JS
DRG No. :	
SCALE : 1:25,000	PRINT : A3

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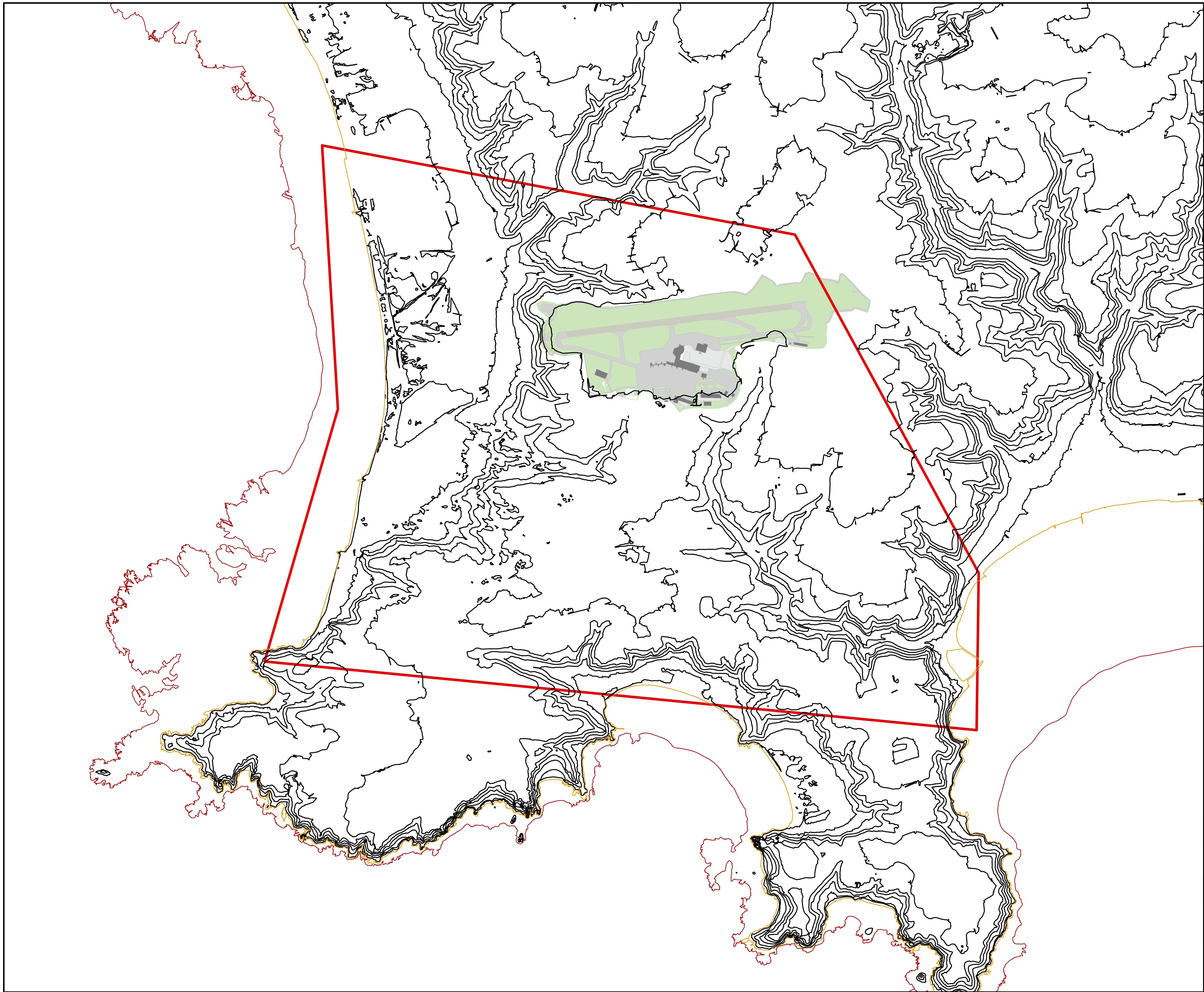


LEGEND

- MEAN HIGH WATER
- MEAN LOW WATER
- CONTOURS - 10M
- MAIN STUDY AREA

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

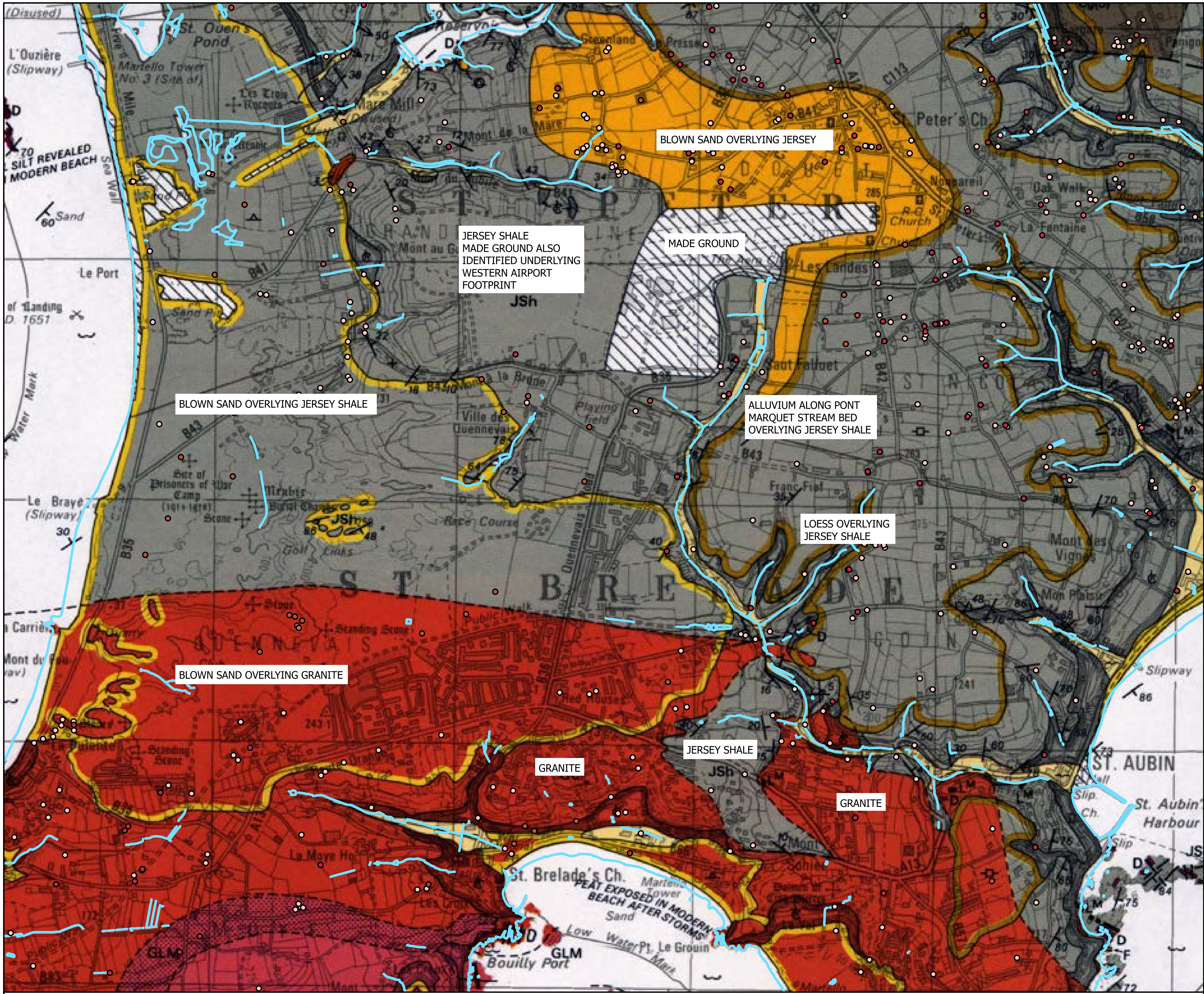
TITLE: STUDY AREA ELEVATION PLAN

SITE : JERSEY

CLIENT : STATES OF JERSEY

PROJECT : 10050570	FIGURE 3
DATE : 30/08/22	DRAWN BY : JS
DRG No. :	
SCALE : 1:25,000	PRINT : A3

ARCADIS



BRITISH GEOLOGICAL SOCIETY

LEGEND

- LICENCED BOREHOLE
- LICENCED SPRING
- LICENCED WELL
- REGISTERED BOREHOLE
- REGISTERED SPRING
- REGISTERED WELL
- OTHER
- WATER COURSES

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE:

SOLID AND DRIFT GEOLOGY ACROSS ST OUEN'S BAY AND PONT MARQUET CATCHMENTS

SITE : **JERSEY**

CLIENT : **STATES OF JERSEY**

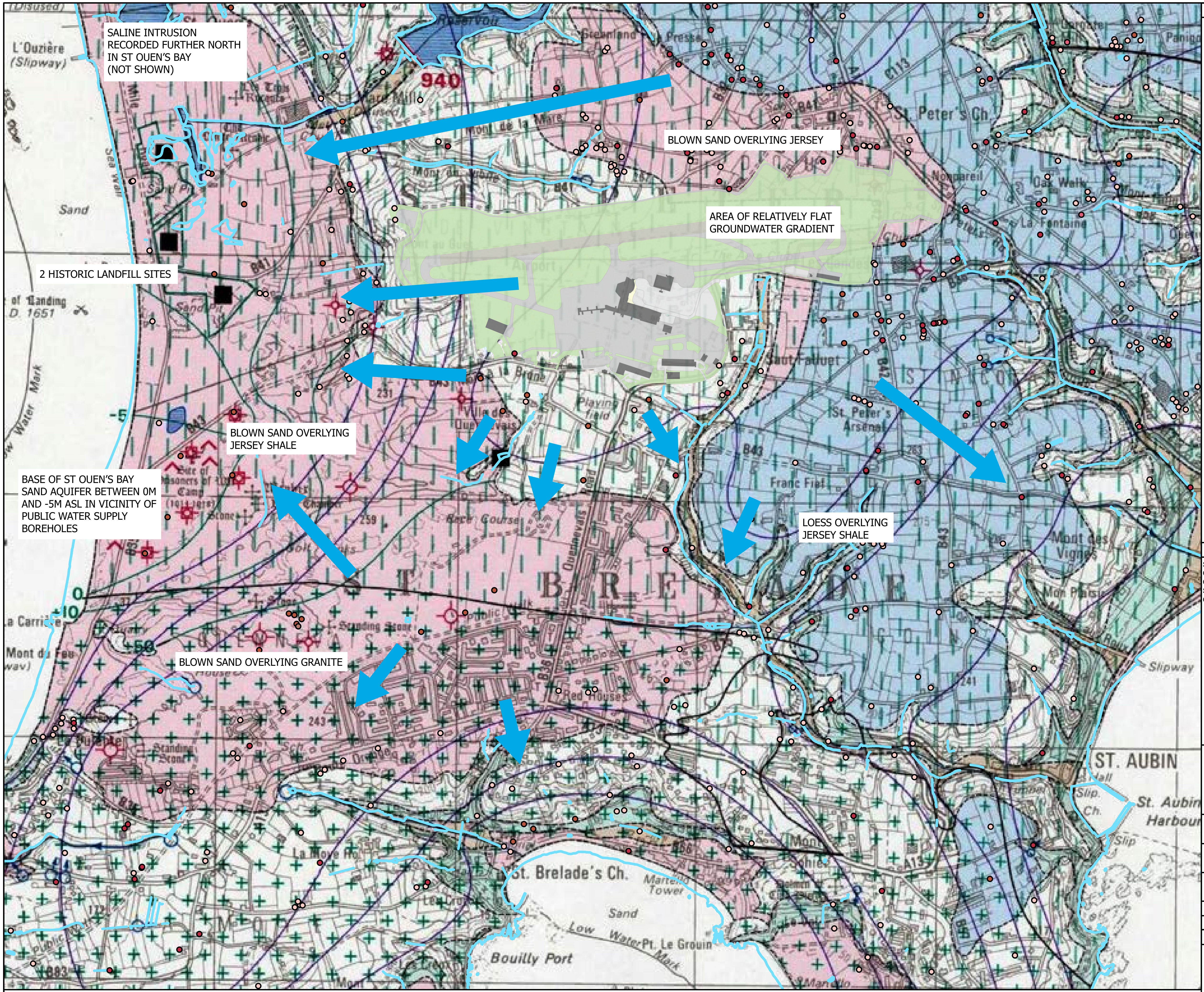
PROJECT : **10050570** **FIGURE 4**

DATE : 30/08/22 DRAWN BY : JS

DRG No. :

SCALE : 1:15,000 PRINT : A3

ARCADIS



BRITISH GEOLOGICAL SOCIETY

LEGEND

- ENVISAGED GROUNDWATER FLOW DIRECTION
- LICENCED BOREHOLE
- LICENCED SPRING
- LICENCED WELL
- REGISTERED BOREHOLE
- REGISTERED SPRING
- REGISTERED WELL
- OTHER
- WATER COURSES

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

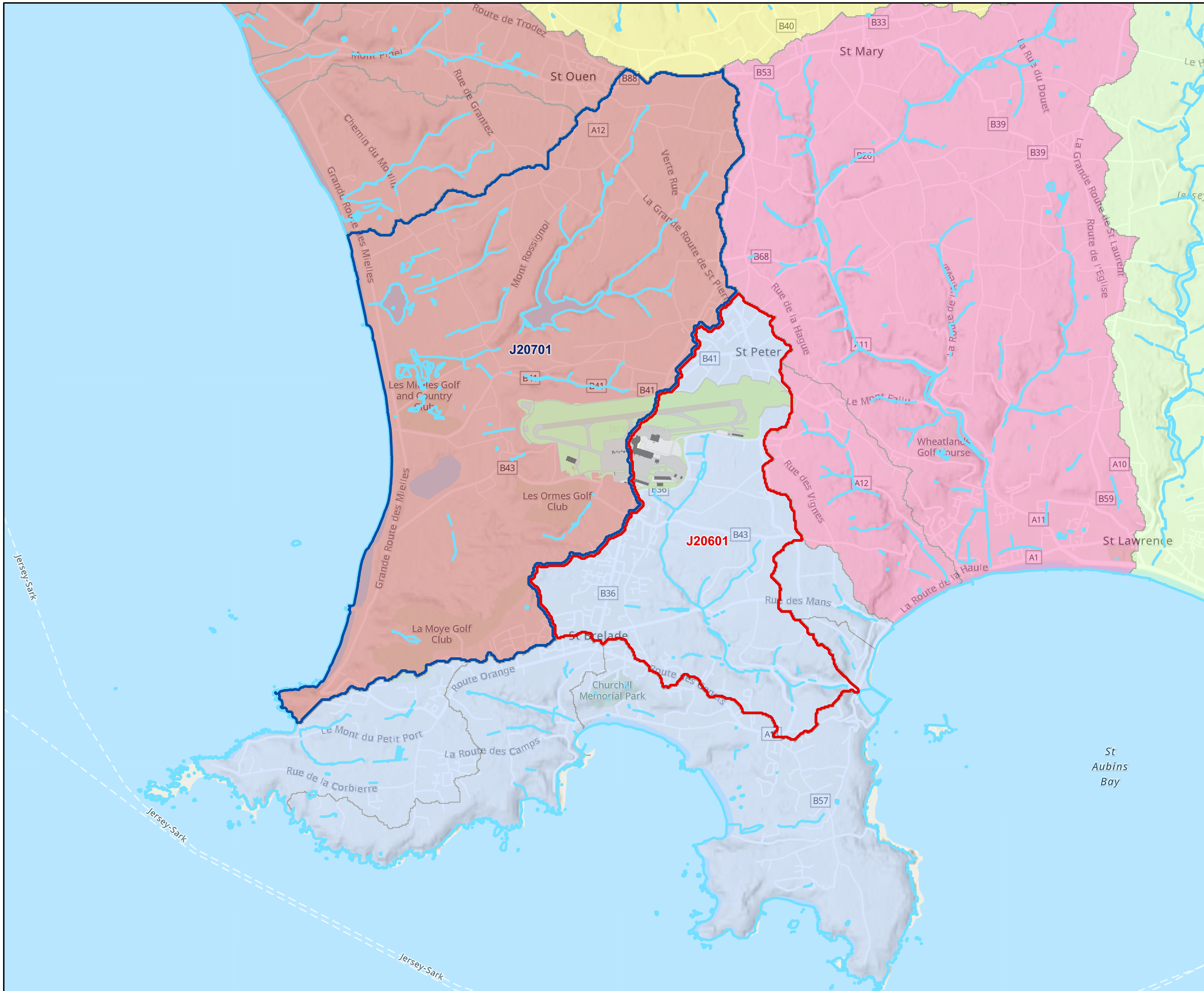
0 1.5 3 6 9 12 15 Metres

N

TITLE:
HYDROGEOLOGICAL MAP OF JERSEY (BGS 1992) SHOWING ST OUEN'S BAY AND PONT MARQUET CATCHMENTS

SITE : JERSEY	
CLIENT : STATES OF JERSEY	
PROJECT : 10050570	FIGURE 5
DATE : 30/08/22	DRAWN BY : JS
DRG No. :	
SCALE : 1:15,000	PRINT : A3

ARCADIS



LEGEND

- WATER COURSES
- BEAUMONT AND ST PETERS VALLEY
- NORTHWEST
- ST AUBIN ST BRELADE AND SOUTHWEST
- ST OUEN AND WEST
- WATERWORKS VALLEY AND BELLOZANNE VALLEY
- CATCHMENT 1
- CATCHMENT 2

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE:	**STUDY AREA STREAM CATCHMENTS**
SITE :	**JERSEY**
CLIENT :	**STATES OF JERSEY**
PROJECT : **10050570**	**FIGURE 6**
DATE : 30/08/22	DRAWN BY : JS
DRG No. :	
SCALE : 1:30,000	PRINT : A3

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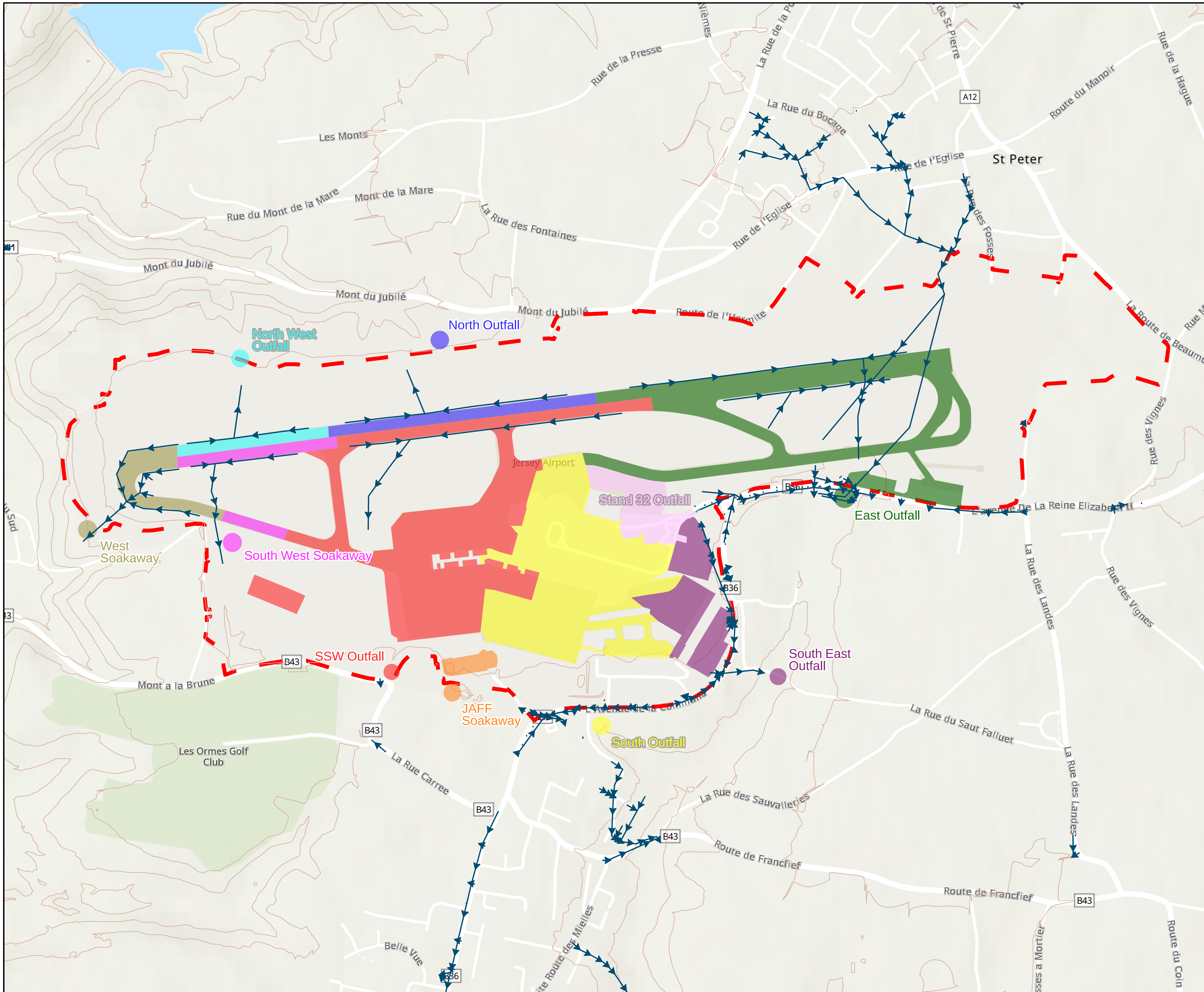

DATA SUPPLIED BY STATES OF JERSEY (2022)
ESRI, INTERMAP, NASA, NGA, USGS, ESRI COMMUNITY MAPS CONTRIBUTORS, ESRI, HERE, GARMIN, FOURSQUARE, GEOTECHNOLOGIES, INC, METI/NASA, USGS

LEGEND

- STORM WATER DRAINAGE
- EAST OUTFALL CATCHMENT AREA
- JAFF SOAKAWAY CATCHMENT AREA
- NORTH OUTFALL CATCHMENT AREA
- NORTH WEST OUTFALL CATCHMENT AREA
- SSW OUTFALL CATCHMENT AREA
- SOUTH EAST OUTFALL CATCHMENT AREA
- SOUTH OUTFALL CATCHMENT AREA
- SOUTH WEST SOAKAWAY CATCHMENT AREA
- STAND 32 OUTFALL CATCHMENT AREA
- WEST SOAKAWAY CATCHMENT AREA
- JERSEY AIRPORT OPERATIONAL AREA

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE: **STORM WATER DRAINAGE OVERVIEW**

SITE: **JERSEY AIRPORT**

CLIENT: **STATES OF JERSEY**

PROJECT: 10050570	FIGURE 7
DATE: 01/11/22	DRAWN BY: JS
DRG No.:	
SCALE: 1:7,500	PRINT: A3

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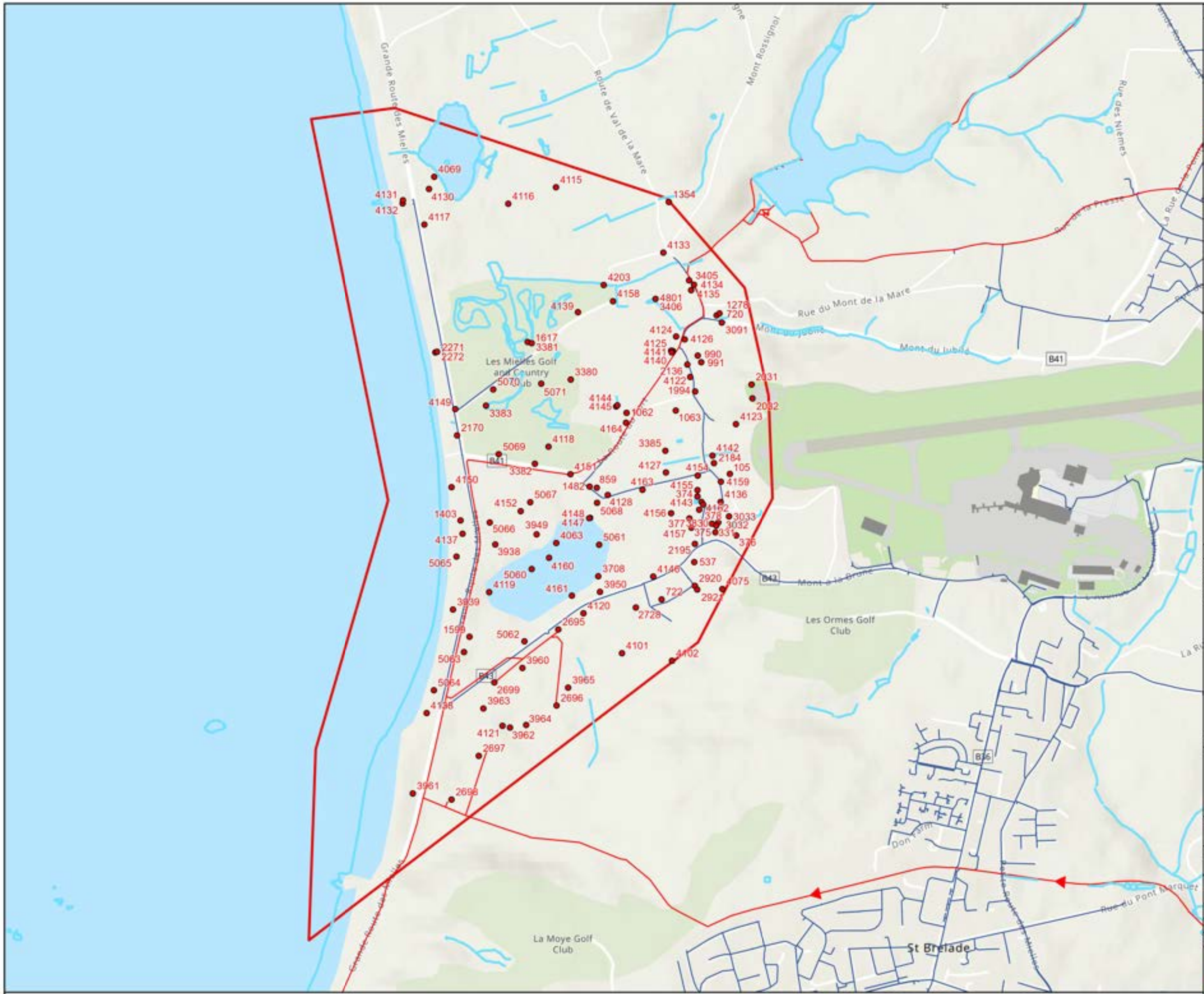

ESRI, INTERMAP, NASA, NGA, USGS, ESRI COMMUNITY MAPS CONTRIBUTORS, ESRI, HERE, GARMIN, FOURSQUARE, GEOTECHNOLOGIES, INC, METI/NASA, USGS

LEGEND

- ABSTRACTIONS
- WATER COURSES
- MAINS TREATED WATER
- MAINS RAW WATER
- STUDY AREA

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE:

BOREHOLES AND ABSTRACTIONS REGISTERED IN THE ST OUEN'S STUDY AREA

SITE: **ST OUEN'S BAY**

CLIENT: **STATES OF JERSEY**

PROJECT:	10050570	FIGURE 8	
DATE:	08/11/22	DRAWN BY:	JS
DRG No.:			
SCALE:	1:12,500	PRINT:	A3

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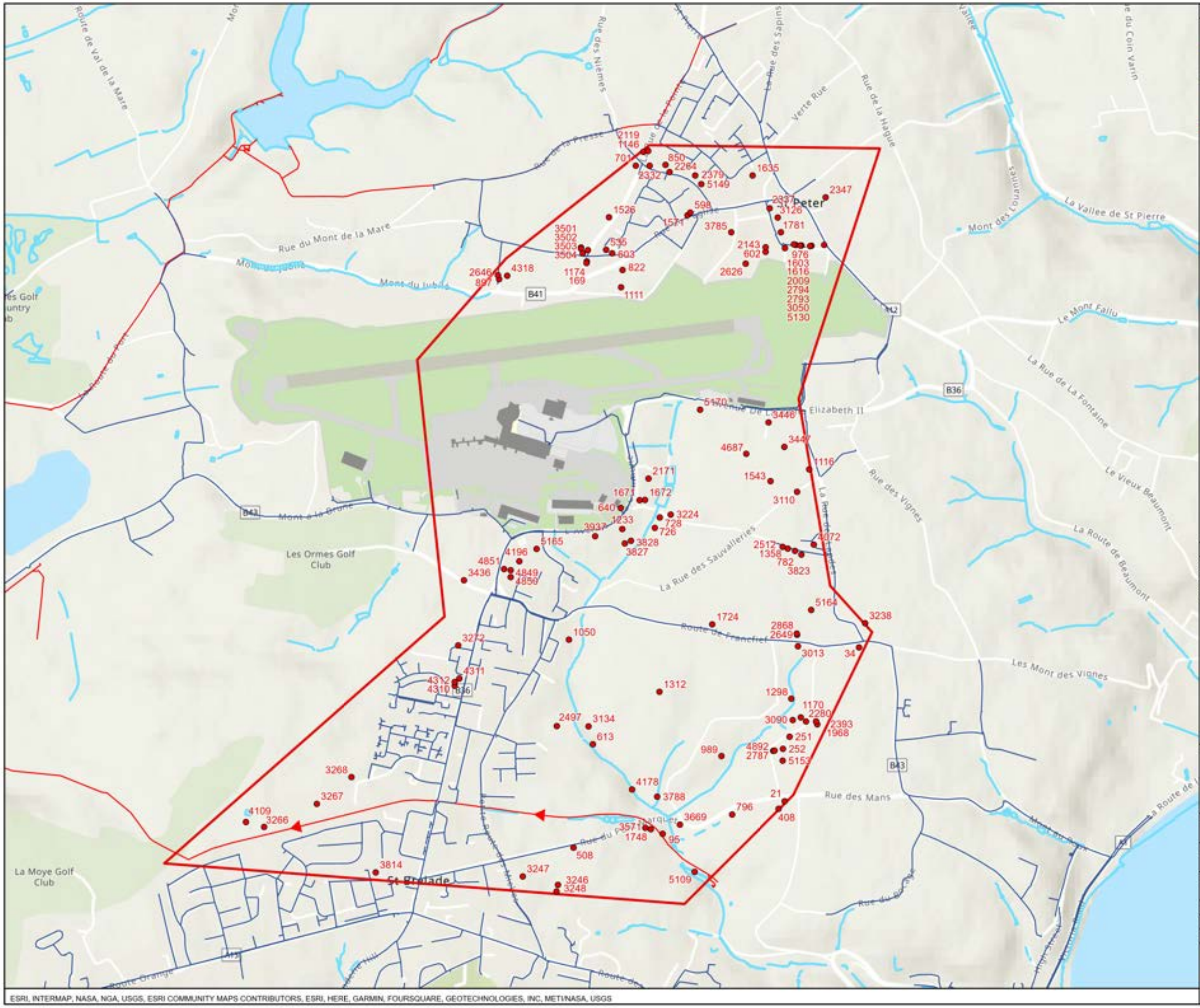

LEGEND

- ABSTRACTIONS
- WATER COURSES
- MAINS TREATED WATER
- MAINS RAW WATER
- STUDY AREA

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE:	BOREHOLES AND ABSTRACTIONS REGISTERED IN THE PONT MARQUET STUDY AREAS
SITE:	PONT MARQUET CATCHMENT
CLIENT:	STATES OF JERSEY
PROJECT: 10050570	FIGURE 9
DATE: 08/11/22	DRAWN BY: JS
DRG No.:	
SCALE: 1:12,500	PRINT: A3

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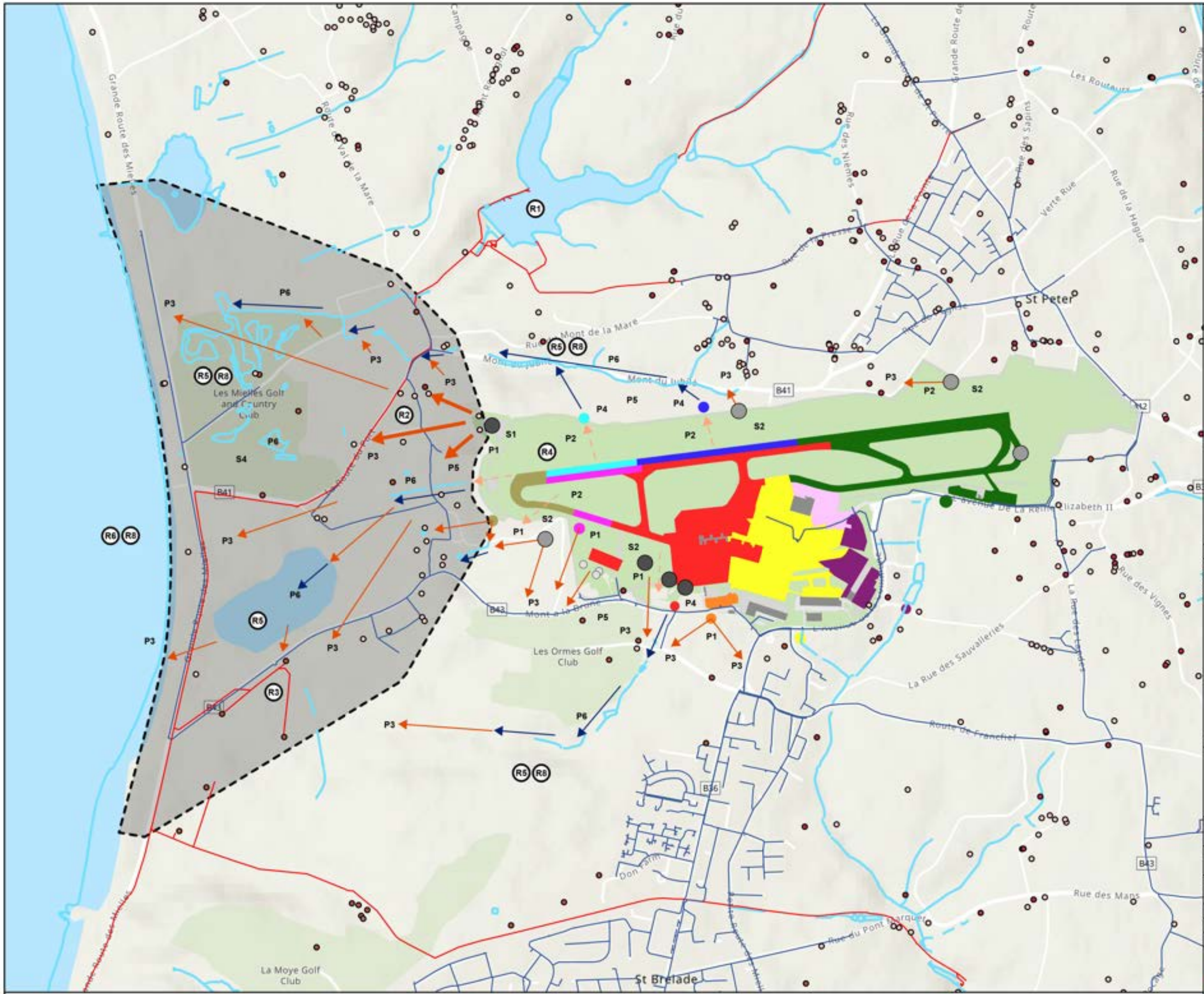

LEGEND

- POTENTIAL GROUNDWATER FLOW PATHWAY FROM HISTORICAL SOURCE AREA
- POTENTIAL GROUNDWATER FLOW PATHWAY
- POTENTIAL PERCHED WATER FLOW PATHWAY
- POTENTIAL SURFACE WATER FLOW PATHWAY
- WATER COURSES
- MAINS TREATED WATER
- MAINS RAW WATER
- LICENCED BOREHOLE
- LICENCED SPRING
- LICENCED WELL
- REGISTERED BOREHOLE
- REGISTERED SPRING
- REGISTERED WELL
- OTHER
- PFOS DETECTIONS IN SOIL
- FOAM SPRAY OFFS (PRE-2000)
- FOAM INCIDENTS
- PFOS_PLUME_AREA

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE: **INITIAL CONCEPTUAL SITE MODEL PLAN VIEW ST OUEN'S BAY CATCHMENT**

SITE: **ST OUEN'S BAY**

CLIENT: **STATES OF JERSEY**

PROJECT: 10050570	FIGURE 10
DATE: 08/11/22	DRAWN BY: JS
DRG No.:	
SCALE: 1:12,500	PRINT: A3

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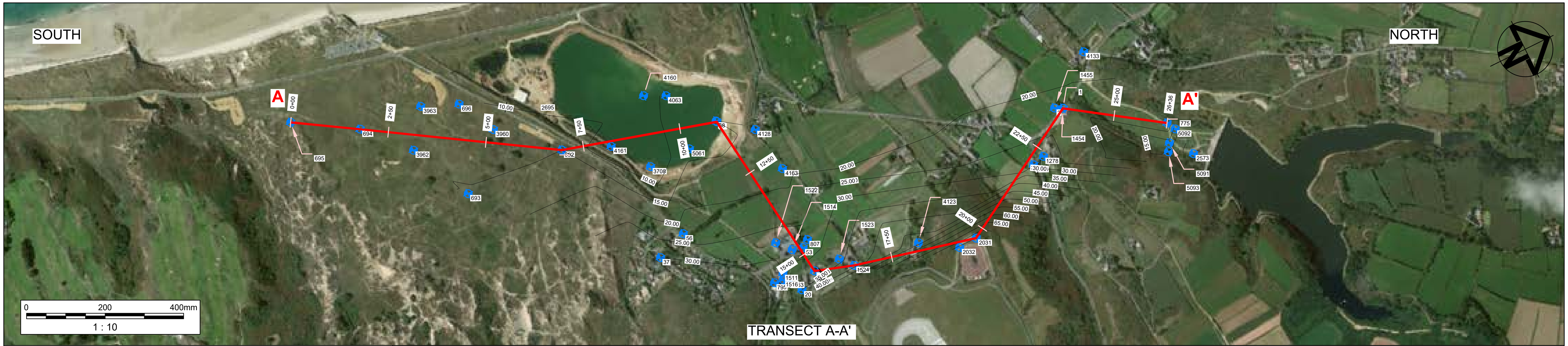
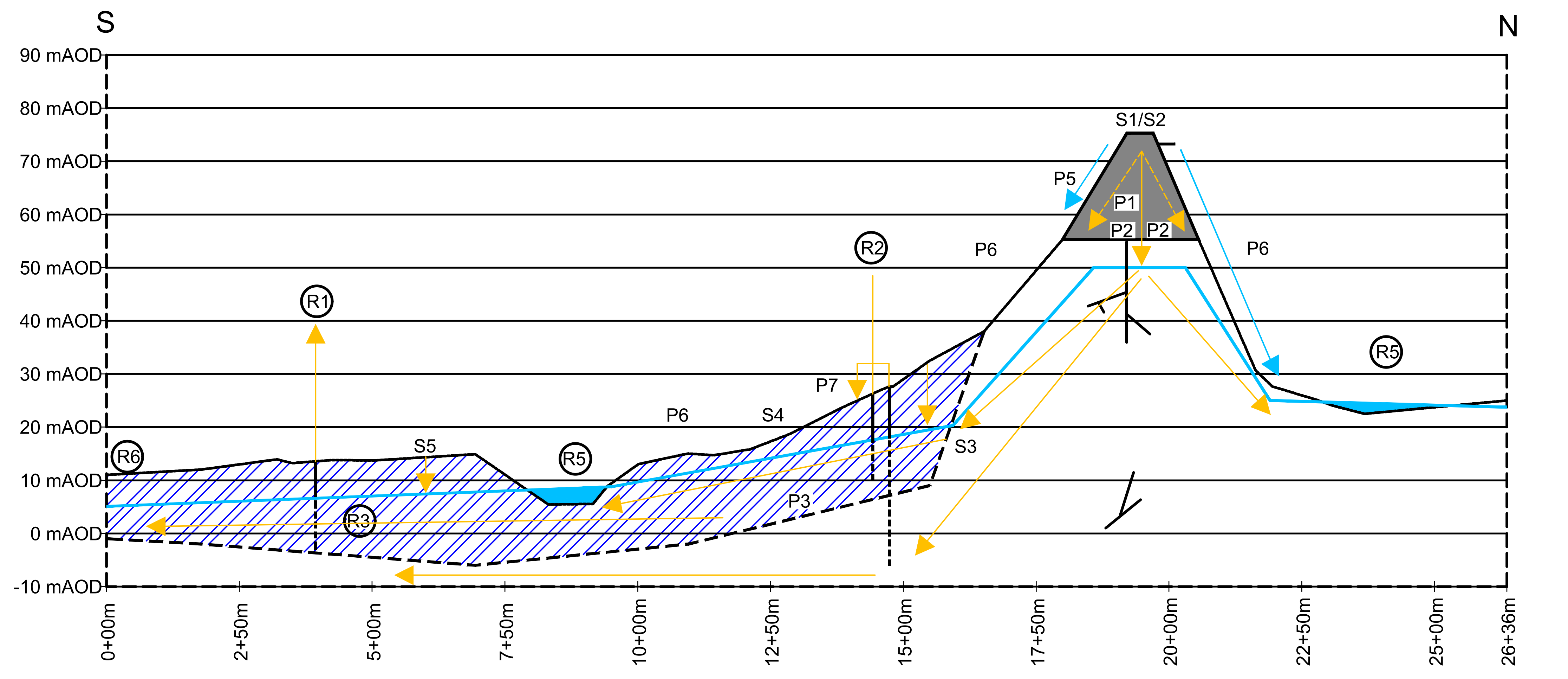


S1 RESIDUAL PFAS IMPACTS WITHIN UNSATURATED SOILS BENEATH THE FTA ASSOCIATED WITH FIREFIGHTING FOAM USAGE.
S2 HISTORICAL PFAS IMPACTS WITHIN UNSATURATED SOILS ACROSS JERSEY AIRPORT ASSOCIATED WITHIN PREVIOUS FIREFIGHTING FOAM USAGE, SPILLAGES AND SOIL MOVEMENTS
S3 PFAS WITHIN SATURATED SOILS AND GROUNDWATER
S4 LAND SPREADING OF BIO SOLIDS WITHIN THE CATCHMENTS – EXACT LOCATIONS CURRENTLY UNKNOWN
S5 HISTORICAL LANDFILLS WITHIN St OUEN'S BAY - DEPOSITED
S6 LOCALISED PFAS SOURCES / DISCHARGES IN THE VICINITY OF St AUBIN
P1 VERTICAL MIGRATION OF PFAS THROUGH UNSATURATED SOILS TO PERCHED WATER AND UNDERLYING GROUNDWATER VIA SOIL LEACHING ASSOCIATED WITH HISTORICAL SOIL IMPACTS AND SOAKAWAYS
P2 LATERAL MIGRATION OF PFAS WITHIN PERCHED WATER TO IDENTIFIED SURFACE WATER RECEPTORS E.G. AS SPRINGS
P3 VERTICAL AND LATERAL MIGRATION OF PFAS WITHIN GROUNDWATER TO IDENTIFIED SURFACE WATER RECEPTORS (INCLUDING INLAND FRESHWATER AND THE COASTAL MARINE ENVIRONMENTS) AND GROUNDWATER ABSTRACTIONS
P4 PREFERENTIAL PATHWAYS ASSOCIATED WITH AIRPORT DRAINAGE INCLUDING THE DISCHARGE OF PFAS WITHIN STORMWATER TO IDENTIFIED SURFACE WATER RECEPTORS VIA DRAINAGE OUTFALLS
P5 SURFACE WATER RUNOFF
P6 LATERAL MIGRATION OF PFAS WITHIN SURFACE WATER INCLUDING STREAMS, TRIBUTARIES AND PONDS
P7 ABSTRACTED GROUNDWATER USED FOR CROP AND FOOD IRRIGATION AND LIVESTOCK FEEDING AND DIRECT PLANT UPTAKE
R1 JERSEY RESIDENTS CONSUMING MAINS PUBLIC WATER SUPPLY – A BLEND OF SOURCES WHICH ONLY IN EXCEPTIONAL SITUATIONS MAY CONTAIN WATER ABSTRACTED VIA BOREHOLES WITHIN THE ST OUEN'S BAY BLOWN SAND AQUIFER AND VIA THE SURFACE WATER ABSTRACTION FROM THE PONT MARQUET STREAM, WHEN JERSEY WATER ARE CERTAIN THAT WATER QUALITY STANDARDS WOULD BE MET
R2 OCCUPANTS OF NEARBY RESIDENTIAL PROPERTIES CONSUMING ABSTRACTED GROUNDWATER
R3 GROUNDWATER WITHIN THE ST OUEN'S BAY BLOWN SAND AQUIFER
R4 GROUNDWATER WITHIN THE JERSEY SHALE FORMATION
R5 SURFACE WATER – WATER FILLED PITS, OUTFALL DRAINS AND STREAMS
R6 SURFACE WATER – COASTAL MARINE ENVIRONMENT
R7 CONSUMERS OF CROPS, FOODSTUFFS AND LIVESTOCK WHERE THERE IS A POTENTIAL FOR PFAS IMPACTED SOIL, BIOSOLIDS, IRRIGATION WATER OR FEED WATER TO HAVE BEEN INVOLVED
R8 ECOLOGICAL RECEPTORS INCLUDING BIOTA WITHIN INLAND FRESHWATER AND COASTAL MARINE ENVIRONMENT



0 400 800mm
1 : 20
VERTICAL SCALE

0 4 8m
1 : 200
HORIZONTAL SCALE

CROSS SECTION A-A'

Rev	Date	Description	Drawn	Check	Approv

NOTE:

Client

Suitability Description:
FOR INFORMATION
NOT TO BE USED FOR CONSTRUCTION

Designed		Date -	Signed
Drawn	KAREPPA	Date --	Signed
Checked	-	Date -	Signed
Approved	-	Date -	Signed
Scale:	1:10	Datum:	--
Original Size:	A3	Grid:	-
Suitability Code:	-	Project Number:	

PROJECT:
JERSEY PROJECT

TITLE:
JERSEY PROJECT
CROSS SECTION A-A'

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Coordinating office: 1st Floor 2 Glass Wharf Temple Quay Bristol, Bs2 0FR
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Drawing Number: F01
Revision: P01

50mm on Original
Print Date: 2022-08-23 15:12:25
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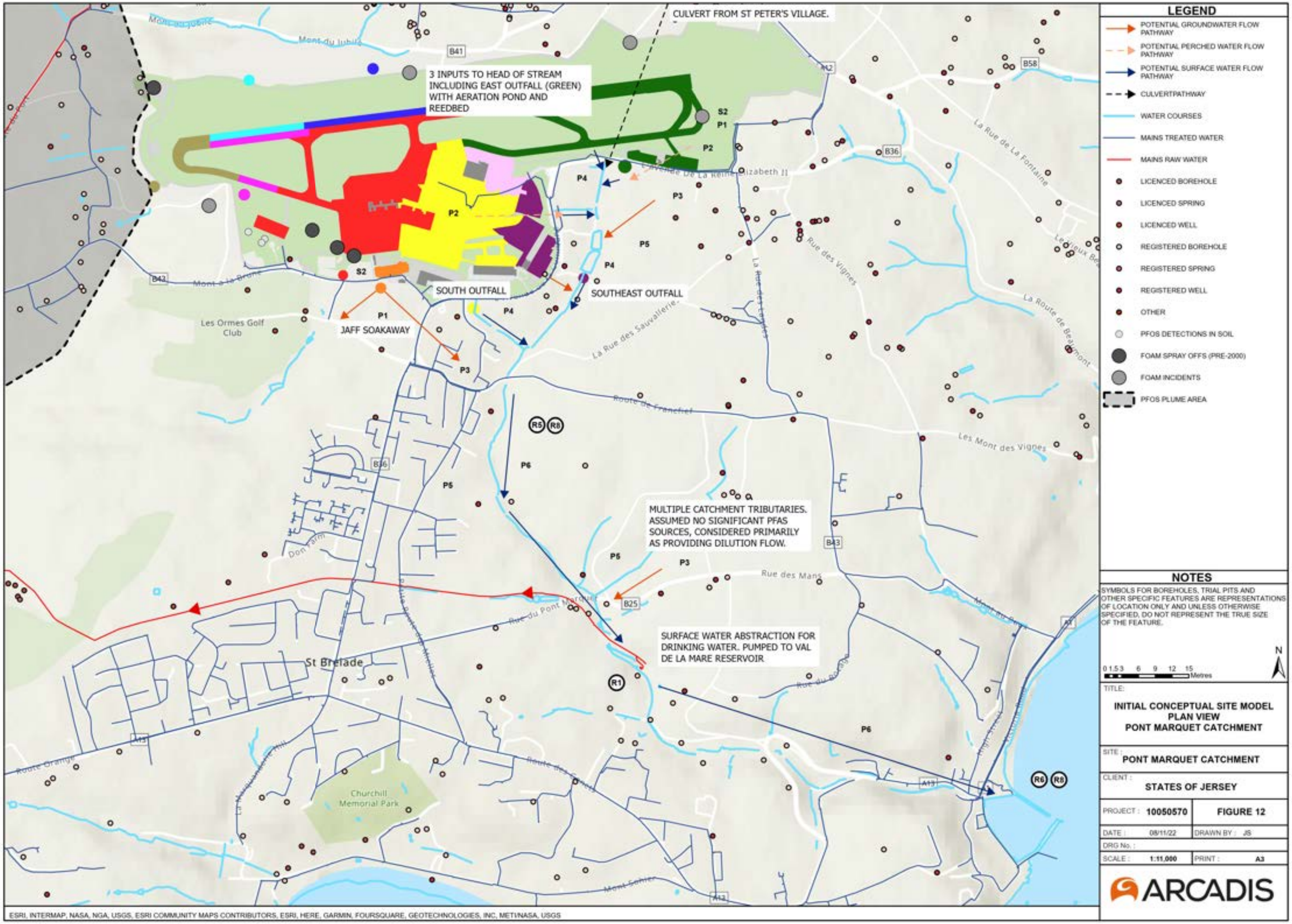

CULVERT FROM ST PETER'S VILLAGE.
3 INPUTS TO HEAD OF STREAM INCLUDING EAST OUTFALL (GREEN) WITH AERATION POND AND REEDBED
SOUTH OUTFALL
SOUTHEAST OUTFALL
JAFF SOAKAWAY
Les Ormes Golf Club
MULTIPLE CATCHMENT TRIBUTARIES. ASSUMED NO SIGNIFICANT PFAS SOURCES, CONSIDERED PRIMARILY AS PROVIDING DILUTION FLOW.
SURFACE WATER ABSTRACTION FOR DRINKING WATER. PUMPED TO VAL DE LA MARE RESERVOIR
St Brelade
Churchill Memorial Park
S2
P1
P2
P3
P4
P5
P6
R1
R5
R6
R8
B41
B42
B36
B58
B43
B25
A13
A3
LEGEND
POTENTIAL GROUNDWATER FLOW PATHWAY
POTENTIAL PERCHED WATER FLOW PATHWAY
POTENTIAL SURFACE WATER FLOW PATHWAY
CULVERTPATHWAY
WATER COURSES
MAINS TREATED WATER
MAINS RAW WATER
LICENCED BOREHOLE
LICENCED SPRING
LICENCED WELL
REGISTERED BOREHOLE
REGISTERED SPRING
REGISTERED WELL
OTHER
PFOS DETECTIONS IN SOIL
FOAM SPRAY OFFS (PRE-2000)
FOAM INCIDENTS
PFOS PLUME AREA
NOTES
SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.
Metres
N
TITLE:
INITIAL CONCEPTUAL SITE MODEL PLAN VIEW PONT MARQUET CATCHMENT
SITE:
PONT MARQUET CATCHMENT
CLIENT:
STATES OF JERSEY
PROJECT: 10050570
FIGURE 12
DATE: 08/11/22
DRAWN BY: JS
DRG No.:
SCALE: 1:11,000
PRINT: A3
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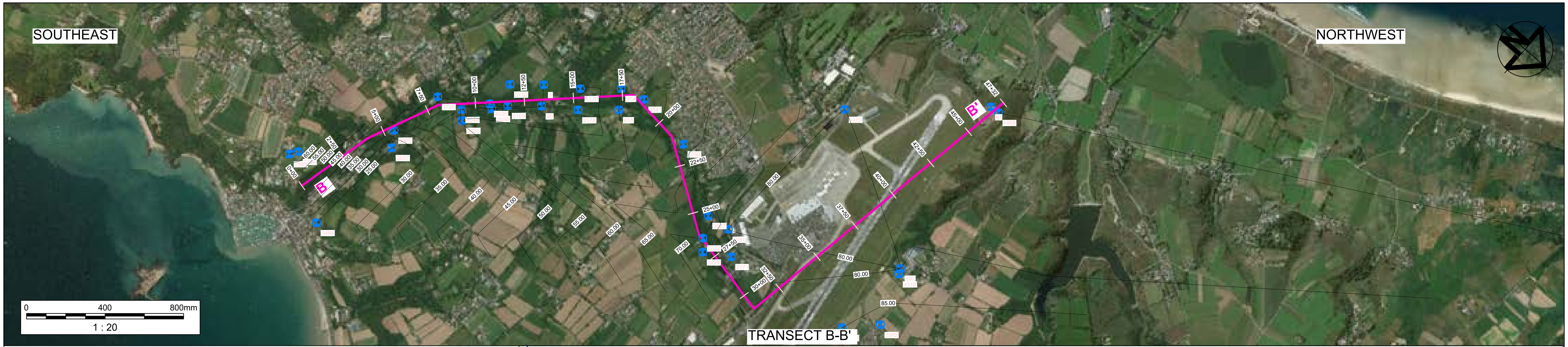
ESRI, INTERMAP, NASA, NGA, USGS, ESRI COMMUNITY MAPS CONTRIBUTORS, ESRI, HERE, GARMIN, FOURSQUARE, GEOTECHNOLOGIES, INC, METI/NASA, USGS



S1 RESIDUAL PFAS IMPACTS WITHIN UNSATURATED SOILS BENEATH THE FTA ASSOCIATED WITH FIREFIGHTING FOAM USAGE.
S2 HISTORICAL PFAS IMPACTS WITHIN UNSATURATED SOILS ACROSS JERSEY AIRPORT ASSOCIATED WITH PREVIOUS FIREFIGHTING FOAM USAGE, SPILLAGES AND SOIL MOVEMENTS
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S4 LAND SPREADING OF BIO SOLIDS WITHIN THE CATCHMENTS – EXACT LOCATIONS CURRENTLY UNKNOWN
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S6 LOCALISED PFAS SOURCES / DISCHARGES IN THE VICINITY OF St AUBIN
P1 VERTICAL MIGRATION OF PFAS THROUGH UNSATURATED SOILS TO PERCHED WATER AND UNDERLYING GROUNDWATER VIA SOIL LEACHING ASSOCIATED WITH HISTORICAL SOIL IMPACTS AND SOAKAWAYS
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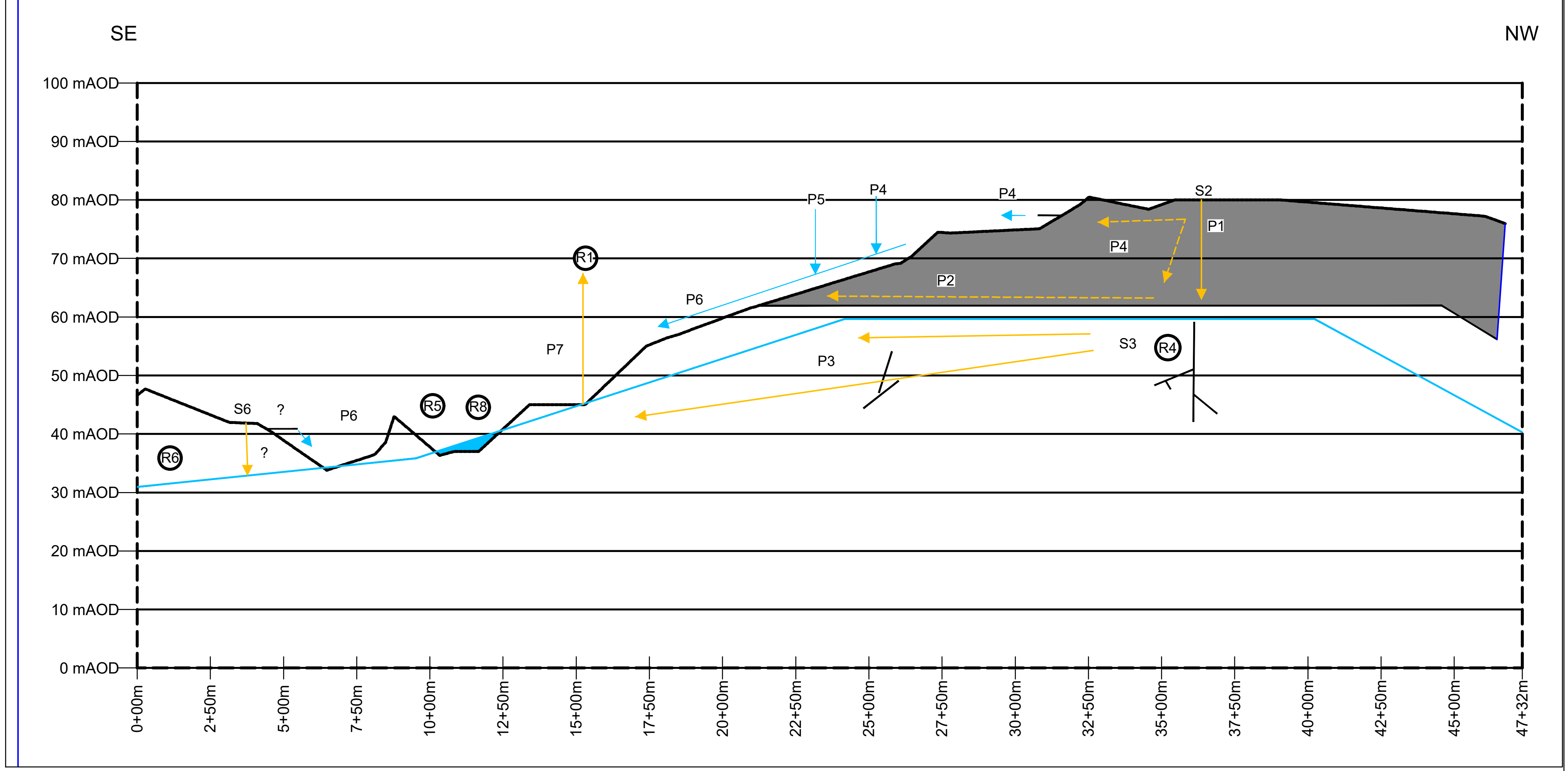
R7 CONSUMERS OF CROPS, FOODSTUFFS AND LIVESTOCK WHERE THERE IS A POTENTIAL FOR PFAS IMPACTED SOIL, BIOSOLIDS, IRRIGATION WATER OR FEED WATER TO HAVE BEEN INVOLVED
R8 ECOLOGICAL RECEPTORS INCLUDING BIOTA WITHIN INLAND FRESHWATER AND COASTAL MARINE ENVIRONMENT



CROSS SECTION B-B'

0	500	1000mm
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VERTICAL SCALE

0	10	20m
	1 : 500	

HORIZONTAL SCALE

Rev	Date	Description	Drawn	Check	Approv

NOTE:

Client

Suitability Description:
FOR INFORMATION
NOT TO BE USED FOR CONSTRUCTION

Designed		Date -	Signed
Drawn	KAREPPA	Date --	Signed
Checked	-	Date -	Signed
Approved	-	Date -	Signed
Scale:	1:20	Datum:	--
Original Size:	A3	Grid:	-
Suitability Code:	-	Project Number:	

PROJECT:
JERSEY PROJECT

TITLE:
JERSEY PROJECT
CROSS SECTION B-B'

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Coordinating office: 1st Floor 2 Glass Wharf Temple Quay Bristol, Bs2 0FR
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Drawing Number: F02
Revision: P01

50mm on Original
Print Date: 2022-08-23 15:13:14
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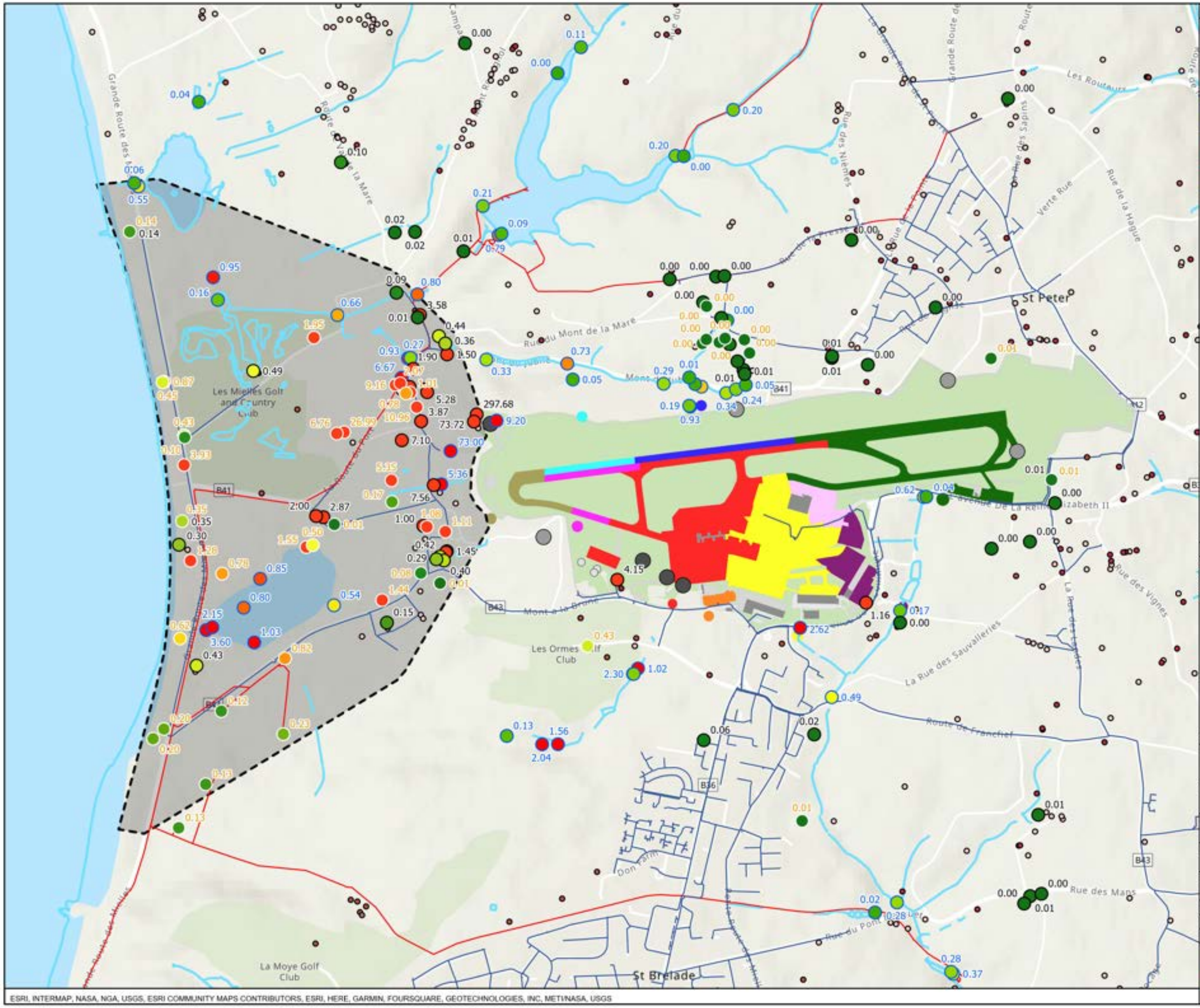

LEGEND

GROUND WATER JERSEY SHALE / GROUND WATER BLOWN SAND / SURFACE WATER

- LOWER CONCENTRATION
- MEDIUM CONCENTRATION
- HIGHER CONCENTRATION
- WATER COURSES
- MAINS TREATED WATER
- MAINS RAW WATER
- LICENCED BOREHOLE
- LICENCED SPRING
- LICENCED WELL
- REGISTERED BOREHOLE
- REGISTERED SPRING
- REGISTERED WELL
- OTHER
- PFOS DETECTIONS IN SOIL
- FOAM SPRAY OFFS (PRE-2000)
- FOAM INCIDENTS
- PFOS_PLUME_AREA

NOTES

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0 1.5 3 6 9 12 15 Metres

N

TITLE:	AVERAGE (MEAN) PFOS CONCENTRATIONS IN GROUNDWATER AND SURFACE WATER (1999-2021)
SITE:	ST OUEN'S BAY
CLIENT:	STATES OF JERSEY
PROJECT: 10050570	FIGURE 14
DATE: 08/11/22	DRAWN BY: JS
DRG No.:	
SCALE: 1:12,500	PRINT: A3

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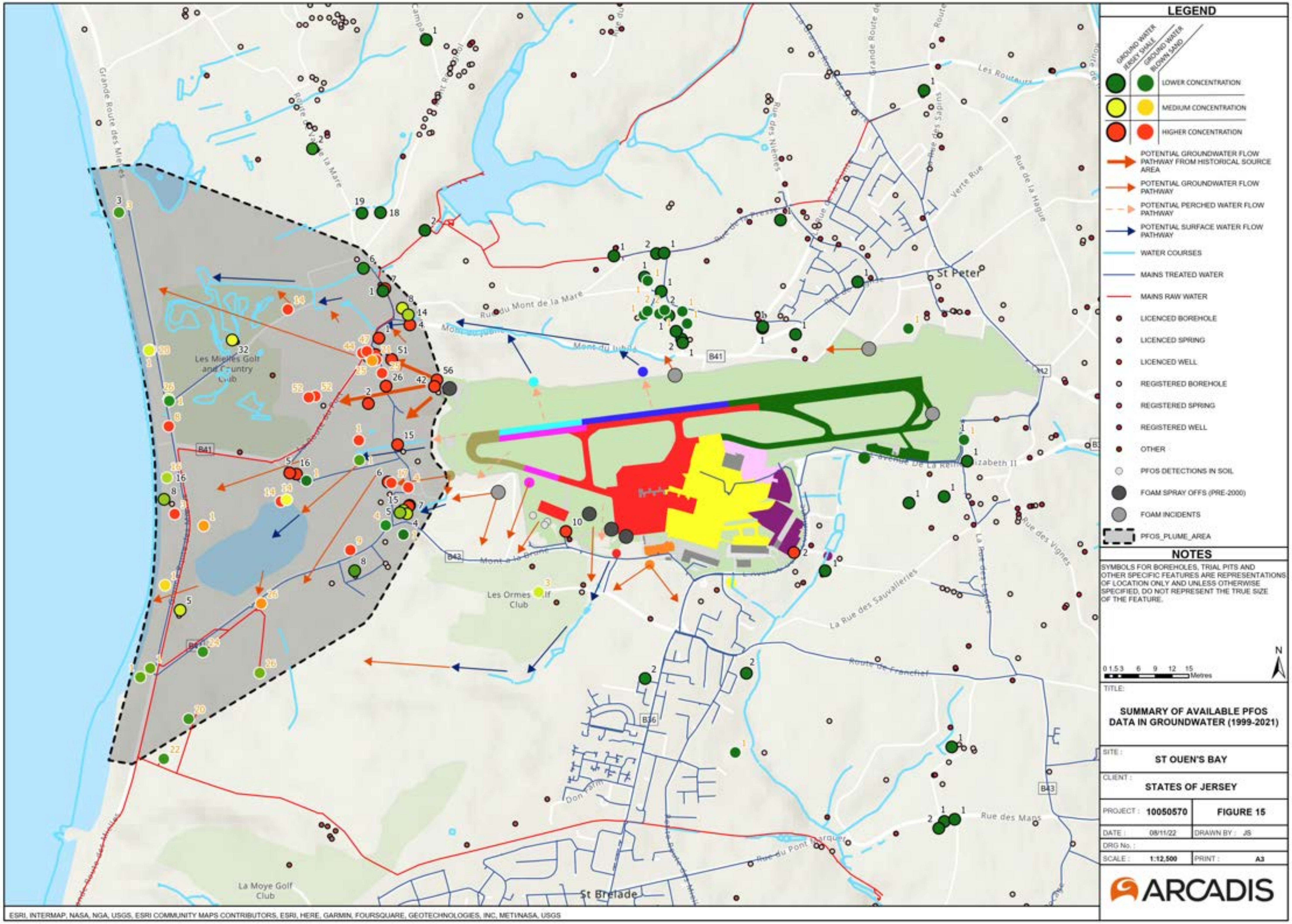
LEGEND
GROUND WATER JERSEY SHALE
GROUND WATER BLOWN SAND
LOWER CONCENTRATION
MEDIUM CONCENTRATION
HIGHER CONCENTRATION
POTENTIAL GROUNDWATER FLOW PATHWAY FROM HISTORICAL SOURCE AREA
POTENTIAL GROUNDWATER FLOW PATHWAY
POTENTIAL PERCHED WATER FLOW PATHWAY
POTENTIAL SURFACE WATER FLOW PATHWAY
WATER COURSES
MAINS TREATED WATER
MAINS RAW WATER
LICENCED BOREHOLE
LICENCED SPRING
LICENCED WELL
REGISTERED BOREHOLE
REGISTERED SPRING
REGISTERED WELL
OTHER
PFOS DETECTIONS IN SOIL
FOAM SPRAY OFFS (PRE-2000)
FOAM INCIDENTS
PFOS_PLUME_AREA
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0 1.5 3 6 9 12 15 Metres
N
TITLE:
SUMMARY OF AVAILABLE PFOS DATA IN GROUNDWATER (1999-2021)
SITE: ST OUEN'S BAY
CLIENT: STATES OF JERSEY
PROJECT: 10050570
FIGURE 15
DATE: 08/11/22
DRAWN BY: JS
DRG No.:
SCALE: 1:12,500
PRINT: A3
ARCADIS
Les Mielles Golf and Country Club
Les Ormes Golf Club
La Moye Golf Club
St Peter
St Brelade
Rue du Mont de la Mare
Mont du Jubilé
Mont à la Brune
La Rue des Sauvalleries
Route de Francfief
Rue des Maps
Rue du Pont Marquet
Grande Route des Mielles
Rue de la Hague
Verte Rue
Les Routeurs
Avenue de la Reine Elizabeth II
Rue des Vignes
B41
B42
B43
B36
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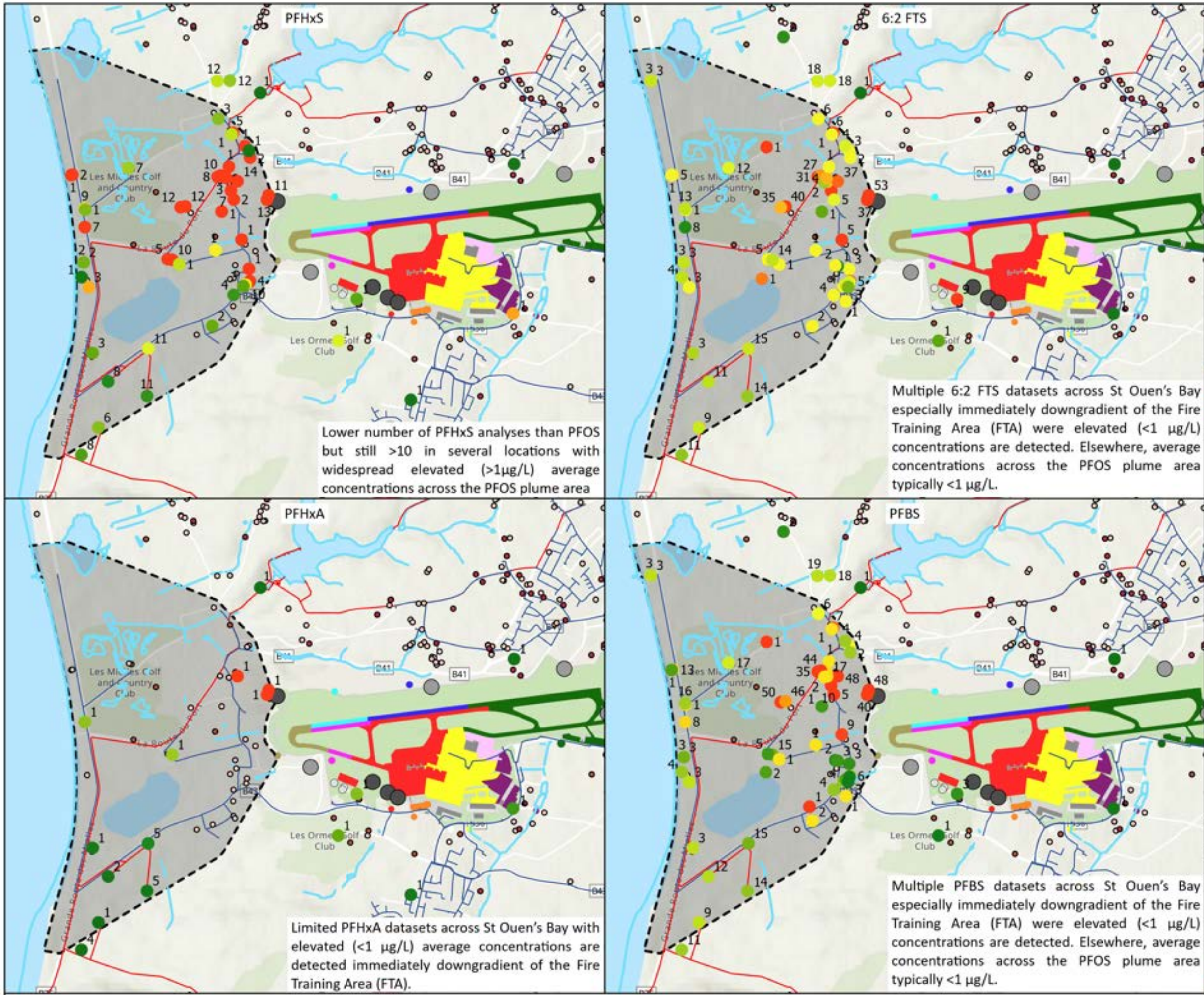

JERSEY WATER, ESRI, INTERMAP, NASA, NGA, USGS, ESRI, HERE, GARMIN, FOURSQUARE, GEOTECHNOLOGIES, INC, METI/NASA, USGS

LEGEND

- LOWER CONCENTRATION
- MEDIUM CONCENTRATION
- HIGHER CONCENTRATION
- PFOS DETECTIONS IN SOIL
- FOAM SPRAY OFFS (PRE-2000)
- FOAM INCIDENTS
- LICENCED BOREHOLE
- LICENCED SPRING
- LICENCED WELL
- REGISTERED BOREHOLE
- REGISTERED SPRING
- REGISTERED WELL
- OTHER
- MAINS TREATED WATER
- MAINS RAW WATER
- WATER COURSES
- PFOS PLUME AREA

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE:

SUMMARY OF AVAILABLE PFAS DATA (SELECTED COMPOUNDS) IN GROUNDWATER (1999-2021)

SITE: **ST OUEN'S BAY**

CLIENT: **STATES OF JERSEY**

PROJECT:	10050570	FIGURE 16	
DATE:	08/11/22	DRAWN BY:	JS
DRG No.:			
SCALE:	1:20,000	PRINT:	A3

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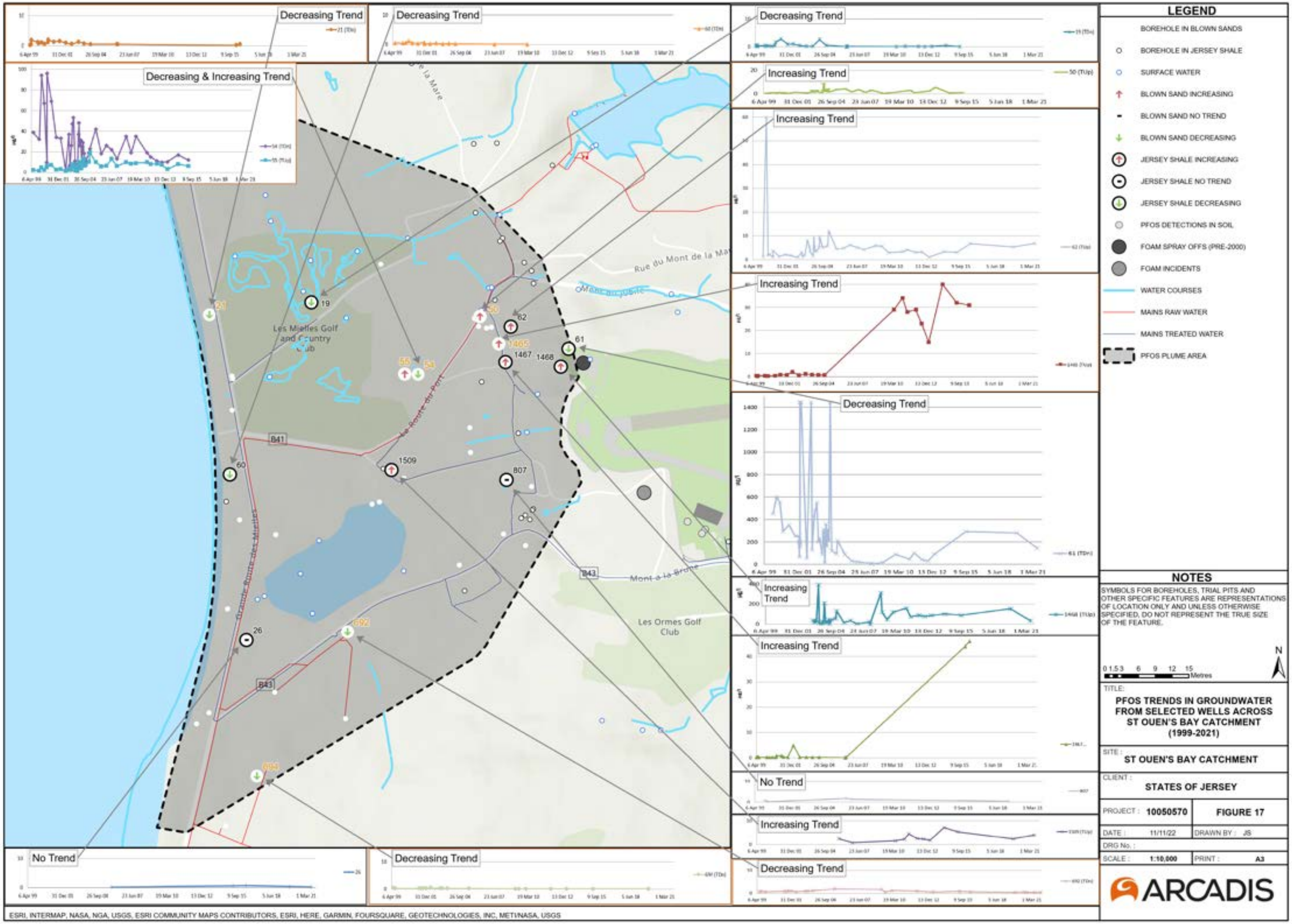

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE:

PFOS TRENDS IN GROUNDWATER FROM SELECTED WELLS ACROSS ST OUEN'S BAY CATCHMENT (1999-2021)

SITE: **ST OUEN'S BAY CATCHMENT**

CLIENT: **STATES OF JERSEY**

PROJECT :	10050570	FIGURE 17	
DATE :	11/11/22	DRAWN BY :	JS
DRG No. :			
SCALE :	1:10,000	PRINT :	A3

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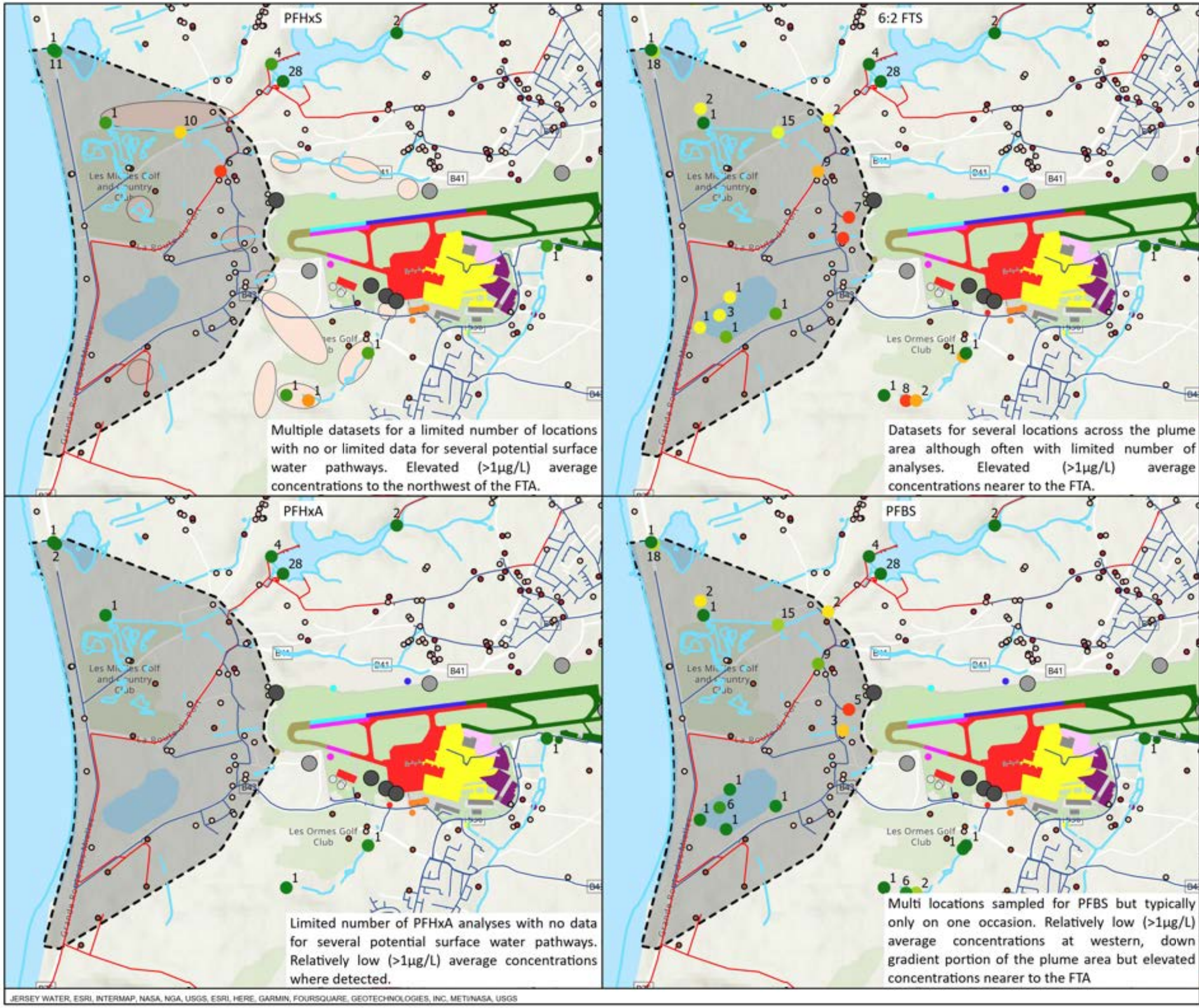

LEGEND

- LOWER CONCENTRATION
- MEDIUM CONCENTRATION
- HIGHER CONCENTRATION
- PFOS DETECTIONS IN SOIL
- FOAM SPRAY OFFS (PRE-2000)
- FOAM INCIDENTS
- LICENCED BOREHOLE
- LICENCED SPRING
- LICENCED WELL
- REGISTERED BOREHOLE
- REGISTERED SPRING
- REGISTERED WELL
- OTHER
- MAINS TREATED WATER
- MAINS RAW WATER
- WATER COURSES
- PFOS PLUME AREA

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE:

SUMMARY OF AVAILABLE PFAS DATA (SELECTED COMPOUNDS) IN SURFACE WATER (1999-2021)

SITE: **ST OUEN'S BAY**

CLIENT: **STATES OF JERSEY**

PROJECT:	10050570	FIGURE 18	
DATE:	08/11/22	DRAWN BY:	JS
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SCALE:	1:20,000	PRINT:	A3

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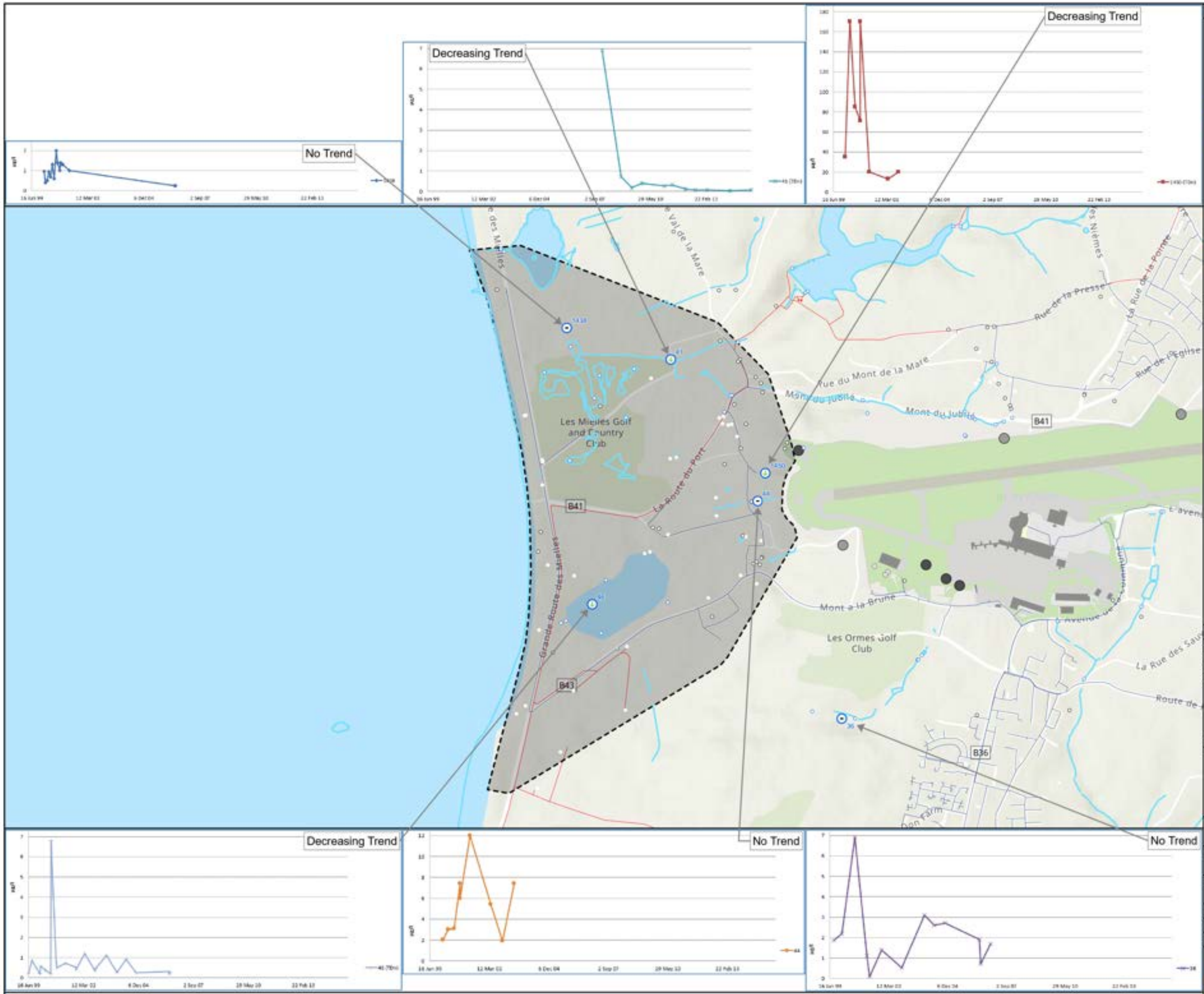

LEGEND

- BOREHOLE IN BLOWN SANDS
- BOREHOLE IN JERSEY SHALE
- SURFACE WATER
- SURFACE WATER INCREASING
- SURFACE WATER NO TREND
- SURFACE WATER DECREASING
- PFOS DETECTIONS IN SOIL
- FOAM SPRAY OFFS (PRE-2000)
- FOAM INCIDENTS
- WATER COURSES
- MAINS RAW WATER
- MAINS TREATED WATER
- PFOS PLUME AREA

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE:

PFOS TRENDS IN SURFACE WATER FROM SELECTED WELLS ACROSS ST OUEN'S BAY CATCHMENT (1999-2021)

SITE: **ST OUEN'S BAY CATCHMENT**

CLIENT: **STATES OF JERSEY**

PROJECT:	10050570	FIGURE 19	
DATE:	11/11/22	DRAWN BY:	JS
DRG No.:			
SCALE:	1:15,000	PRINT:	A3

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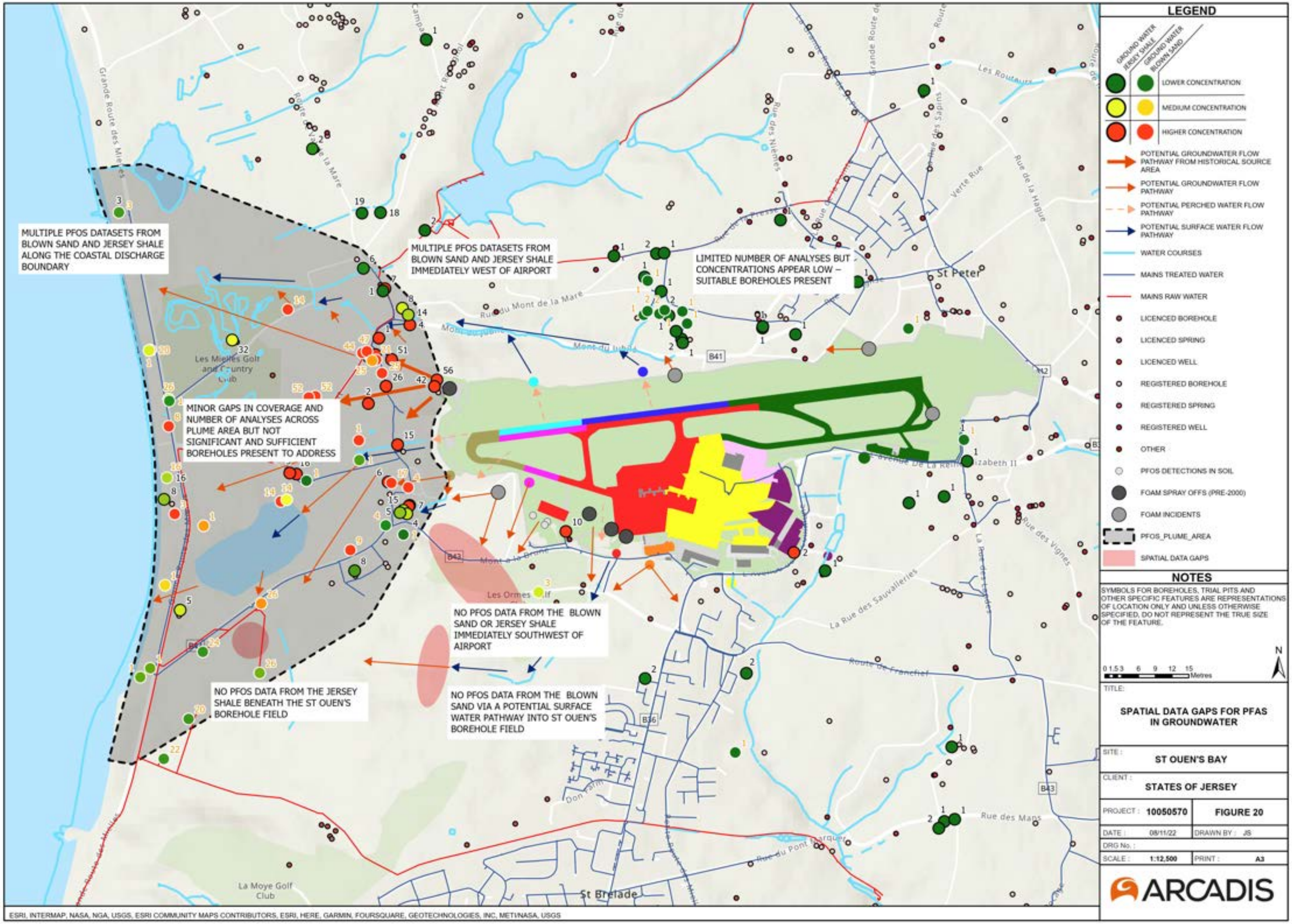

LEGEND
GROUND WATER JERSEY SHALE
GROUND WATER BLOWN SAND
LOWER CONCENTRATION
MEDIUM CONCENTRATION
HIGHER CONCENTRATION
POTENTIAL GROUNDWATER FLOW PATHWAY FROM HISTORICAL SOURCE AREA
POTENTIAL GROUNDWATER FLOW PATHWAY
POTENTIAL PERCHED WATER FLOW PATHWAY
POTENTIAL SURFACE WATER FLOW PATHWAY
WATER COURSES
MAINS TREATED WATER
MAINS RAW WATER
LICENCED BOREHOLE
LICENCED SPRING
LICENCED WELL
REGISTERED BOREHOLE
REGISTERED SPRING
REGISTERED WELL
OTHER
PFOS DETECTIONS IN SOIL
FOAM SPRAY OFFS (PRE-2000)
FOAM INCIDENTS
PFOS_PLUME_AREA
SPATIAL DATA GAPS
NOTES
SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.
MULTIPLE PFOS DATASETS FROM BLOWN SAND AND JERSEY SHALE ALONG THE COASTAL DISCHARGE BOUNDARY
MULTIPLE PFOS DATASETS FROM BLOWN SAND AND JERSEY SHALE IMMEDIATELY WEST OF AIRPORT
LIMITED NUMBER OF ANALYSES BUT CONCENTRATIONS APPEAR LOW – SUITABLE BOREHOLES PRESENT
MINOR GAPS IN COVERAGE AND NUMBER OF ANALYSES ACROSS PLUME AREA BUT NOT SIGNIFICANT AND SUFFICIENT BOREHOLES PRESENT TO ADDRESS
NO PFOS DATA FROM THE BLOWN SAND OR JERSEY SHALE IMMEDIATELY SOUTHWEST OF AIRPORT
NO PFOS DATA FROM THE JERSEY SHALE BENEATH THE ST OUEN'S BOREHOLE FIELD
NO PFOS DATA FROM THE BLOWN SAND VIA A POTENTIAL SURFACE WATER PATHWAY INTO ST OUEN'S BOREHOLE FIELD
Les Mielles Golf and Country Club
La Moye Golf Club
St Peter
St Brelade
Les Ormes Golf
0 1.5 3 6 9 12 15 Metres
TITLE:
SPATIAL DATA GAPS FOR PFAS IN GROUNDWATER
SITE:
ST OUEN'S BAY
CLIENT:
STATES OF JERSEY
PROJECT: 10050570
FIGURE 20
DATE: 08/11/22
DRAWN BY: JS
DRG No.:
SCALE: 1:12,500
PRINT: A3
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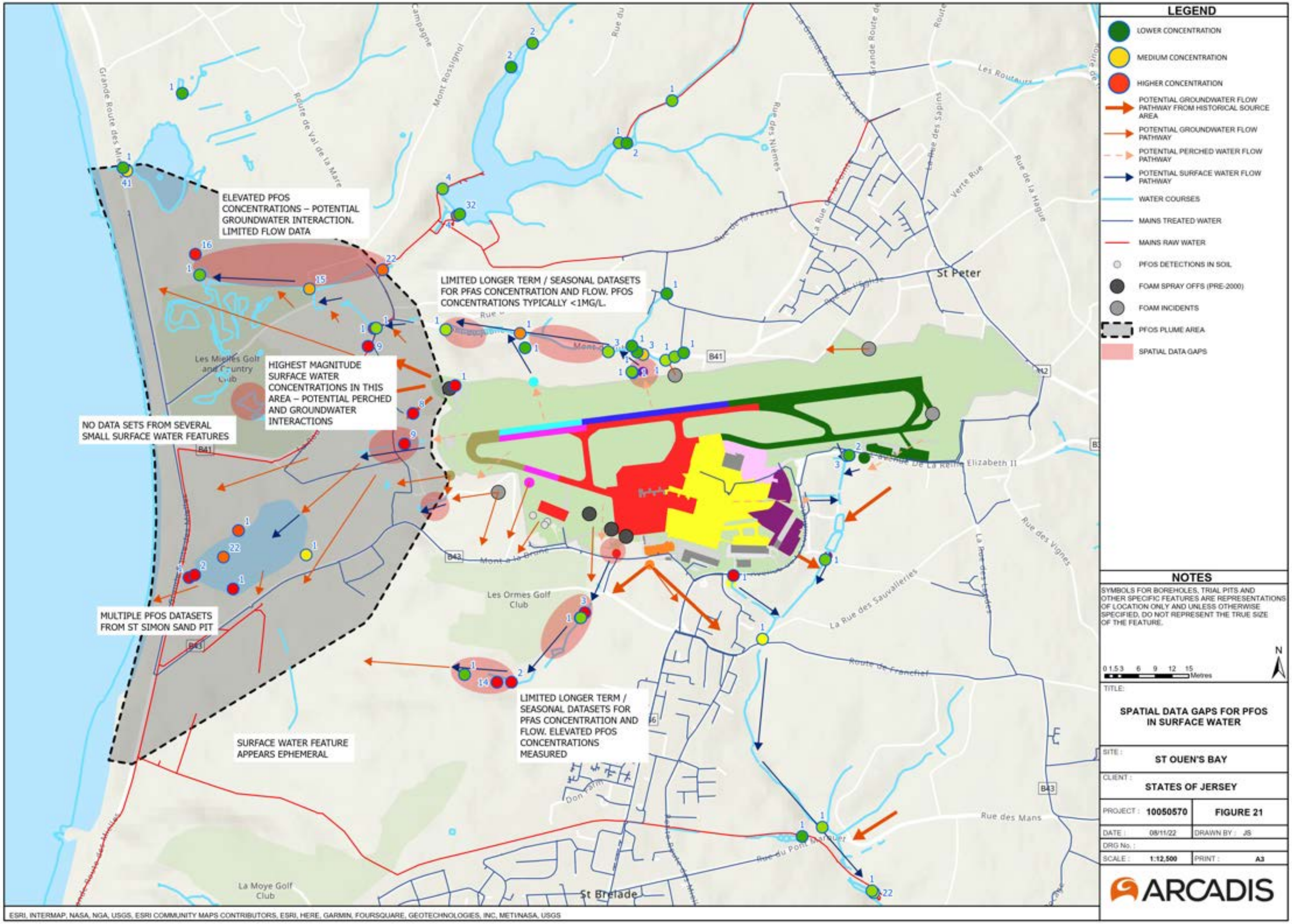
ELEVATED PFOS CONCENTRATIONS – POTENTIAL GROUNDWATER INTERACTION. LIMITED FLOW DATA
LIMITED LONGER TERM / SEASONAL DATASETS FOR PFAS CONCENTRATION AND FLOW. PFOS CONCENTRATIONS TYPICALLY <1MG/L.
HIGHEST MAGNITUDE SURFACE WATER CONCENTRATIONS IN THIS AREA – POTENTIAL PERCHED AND GROUNDWATER INTERACTIONS
NO DATA SETS FROM SEVERAL SMALL SURFACE WATER FEATURES
MULTIPLE PFOS DATASETS FROM ST SIMON SAND PIT
LIMITED LONGER TERM / SEASONAL DATASETS FOR PFAS CONCENTRATION AND FLOW. ELEVATED PFOS CONCENTRATIONS MEASURED
SURFACE WATER FEATURE APPEARS EPHEMERAL
Les Mielles Golf and Country Club
Les Ormes Golf Club
La Moye Golf Club
St Peter
St Brelade
Grande Route des Mielles
Route de Val de la Mare
Mont Rossignol
Rue de la Presse
Rue des Niemes
Verte Rue
Rue de la Hague
Les Routeurs
Rue des Sapins
Avenue De La Reine Elizabeth II
Mont à la Brune
La Rue des Sauvalleries
Rue des Vignes
Route de Francfief
Rue des Mans
Rue du Pont Marquet
Don Farm
B41
B42
B43
LEGEND
LOWER CONCENTRATION
MEDIUM CONCENTRATION
HIGHER CONCENTRATION
POTENTIAL GROUNDWATER FLOW PATHWAY FROM HISTORICAL SOURCE AREA
POTENTIAL GROUNDWATER FLOW PATHWAY
POTENTIAL PERCHED WATER FLOW PATHWAY
POTENTIAL SURFACE WATER FLOW PATHWAY
WATER COURSES
MAINS TREATED WATER
MAINS RAW WATER
PFOS DETECTIONS IN SOIL
FOAM SPRAY OFFS (PRE-2000)
FOAM INCIDENTS
PFOS PLUME AREA
SPATIAL DATA GAPS
NOTES
SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.
N
0 1.5 3 6 9 12 15 Metres
TITLE:
SPATIAL DATA GAPS FOR PFOS IN SURFACE WATER
SITE:
ST OUEN'S BAY
CLIENT:
STATES OF JERSEY
PROJECT: 10050570
FIGURE 21
DATE: 08/11/22
DRAWN BY: JS
DRG No.:
SCALE: 1:12,500
PRINT: A3
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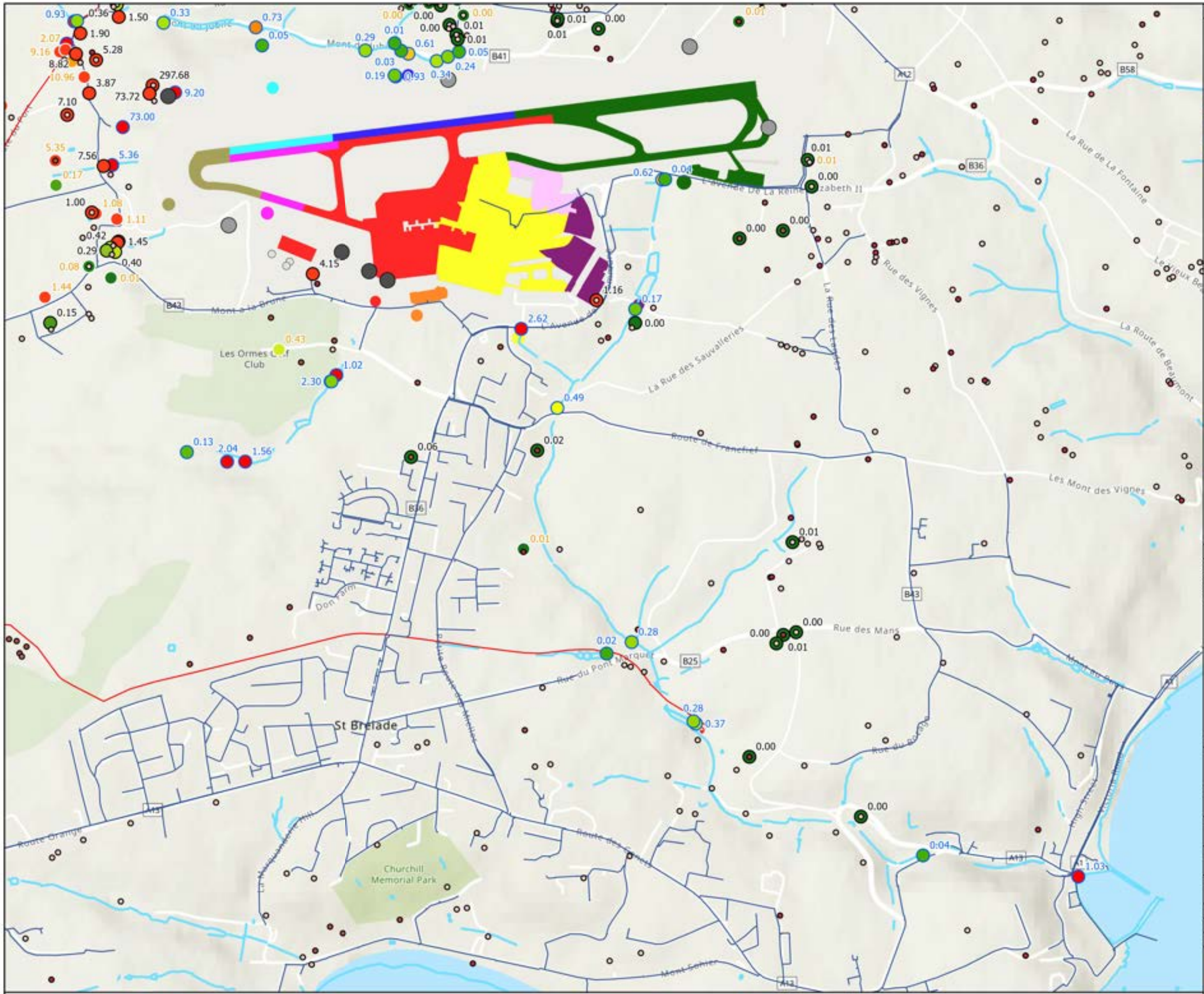

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LEGEND

GROUND WATER JERSEY SHALE | GROUND WATER BLOWN SAND | SURFACE WATER

- LOWER CONCENTRATION
- MEDIUM CONCENTRATION
- HIGHER CONCENTRATION
- LICENCED BOREHOLE
- LICENCED SPRING
- LICENCED WELL
- REGISTERED BOREHOLE
- REGISTERED SPRING
- REGISTERED WELL
- OTHER
- PFOS DETECTIONS IN SOIL
- FOAM SPRAY OFFS (PRE-2000)
- FOAM INCIDENTS
- WATER COURSES
- MAINS RAW WATER
- MAINS TREATED WATER

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE:

AVERAGE (MEAN) PFOS CONCENTRATIONS IN GROUNDWATER AND SURFACE WATER (1999 - 2021)

SITE: **PONT MARQUET CATCHMENT**

CLIENT: **STATES OF JERSEY**

PROJECT: 10050570	FIGURE 22
DATE: 08/11/22	DRAWN BY: JS
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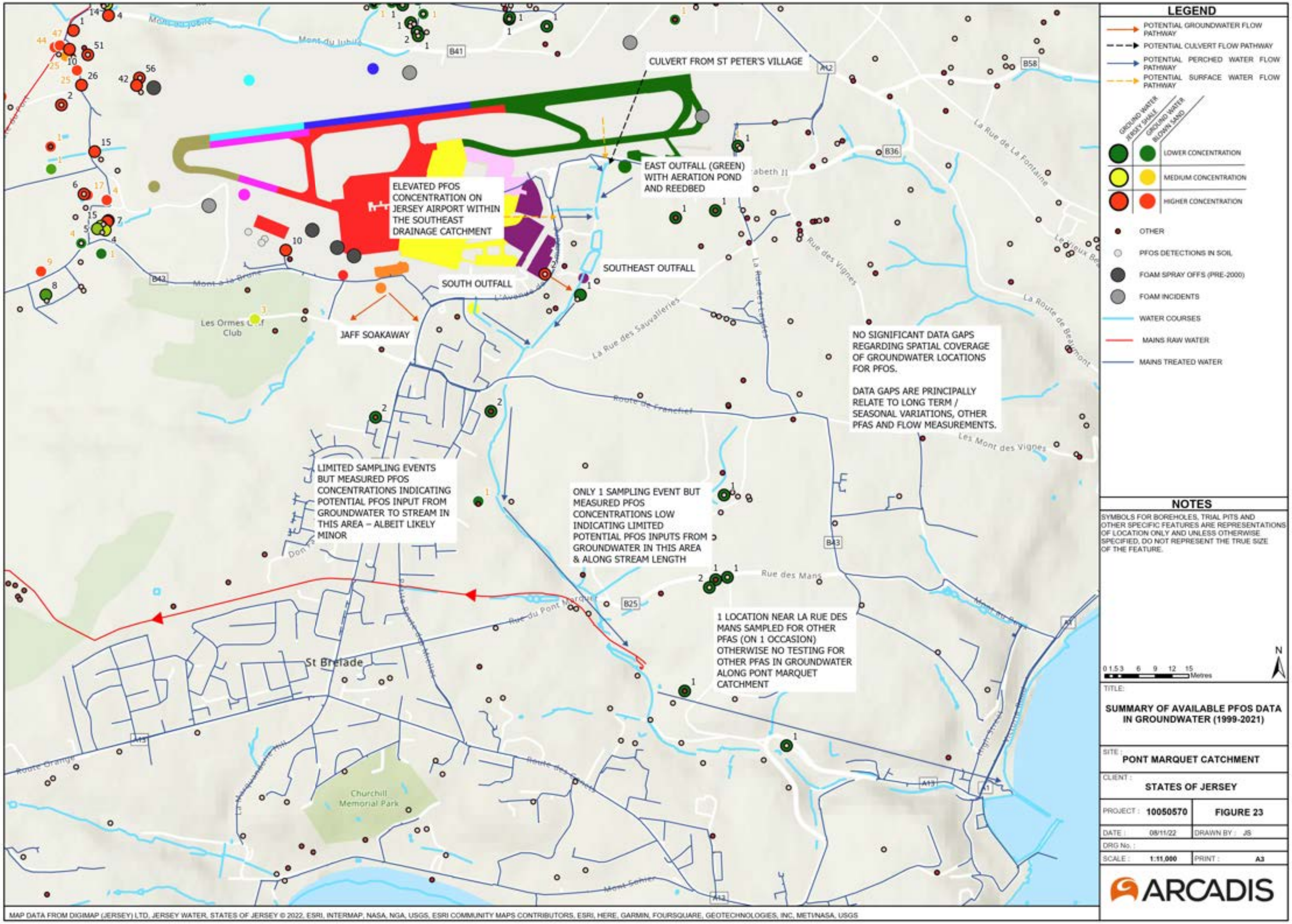
CULVERT FROM ST PETER'S VILLAGE
EAST OUTFALL (GREEN) WITH AERATION POND AND REEDBED
ELEVATED PFOS CONCENTRATION ON JERSEY AIRPORT WITHIN THE SOUTHEAST DRAINAGE CATCHMENT
SOUTHEAST OUTFALL
SOUTH OUTFALL
JAFF SOAKAWAY
Les Ormes Golf Club
NO SIGNIFICANT DATA GAPS REGARDING SPATIAL COVERAGE OF GROUNDWATER LOCATIONS FOR PFOS.
DATA GAPS ARE PRINCIPALLY RELATE TO LONG TERM / SEASONAL VARIATIONS, OTHER PFAS AND FLOW MEASUREMENTS.
LIMITED SAMPLING EVENTS BUT MEASURED PFOS CONCENTRATIONS INDICATING POTENTIAL PFOS INPUT FROM GROUNDWATER TO STREAM IN THIS AREA – ALBEIT LIKELY MINOR
ONLY 1 SAMPLING EVENT BUT MEASURED PFOS CONCENTRATIONS LOW INDICATING LIMITED POTENTIAL PFOS INPUTS FROM GROUNDWATER IN THIS AREA & ALONG STREAM LENGTH
1 LOCATION NEAR LA RUE DES MANS SAMPLED FOR OTHER PFAS (ON 1 OCCASION) OTHERWISE NO TESTING FOR OTHER PFAS IN GROUNDWATER ALONG PONT MARQUET CATCHMENT
St Brelade
Churchill Memorial Park
Rue des Mans
Route de Francfief
La Rue des Sauvalleries
La Rue de La Fontaine
Rue des Vignes
Les Mont des Vignes
Mont du Jubilé
Mont à la Brune
Rue du Pont Marquet
Route Orange
Mont Sohier
B41
B42
B36
B58
B43
B25
A12
A13
A1
LEGEND
POTENTIAL GROUNDWATER FLOW PATHWAY
POTENTIAL CULVERT FLOW PATHWAY
POTENTIAL PERCHED WATER FLOW PATHWAY
POTENTIAL SURFACE WATER FLOW PATHWAY
GROUND WATER JERSEY SHALE
GROUND WATER BLOWN SAND
LOWER CONCENTRATION
MEDIUM CONCENTRATION
HIGHER CONCENTRATION
OTHER
PFOS DETECTIONS IN SOIL
FOAM SPRAY OFFS (PRE-2000)
FOAM INCIDENTS
WATER COURSES
MAINS RAW WATER
MAINS TREATED WATER
NOTES
SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.
N
Metres
TITLE:
SUMMARY OF AVAILABLE PFOS DATA IN GROUNDWATER (1999-2021)
SITE:
PONT MARQUET CATCHMENT
CLIENT:
STATES OF JERSEY
PROJECT: 10050570
FIGURE 23
DATE: 08/11/22
DRAWN BY: JS
DRG No.:
SCALE: 1:11,000
PRINT: A3
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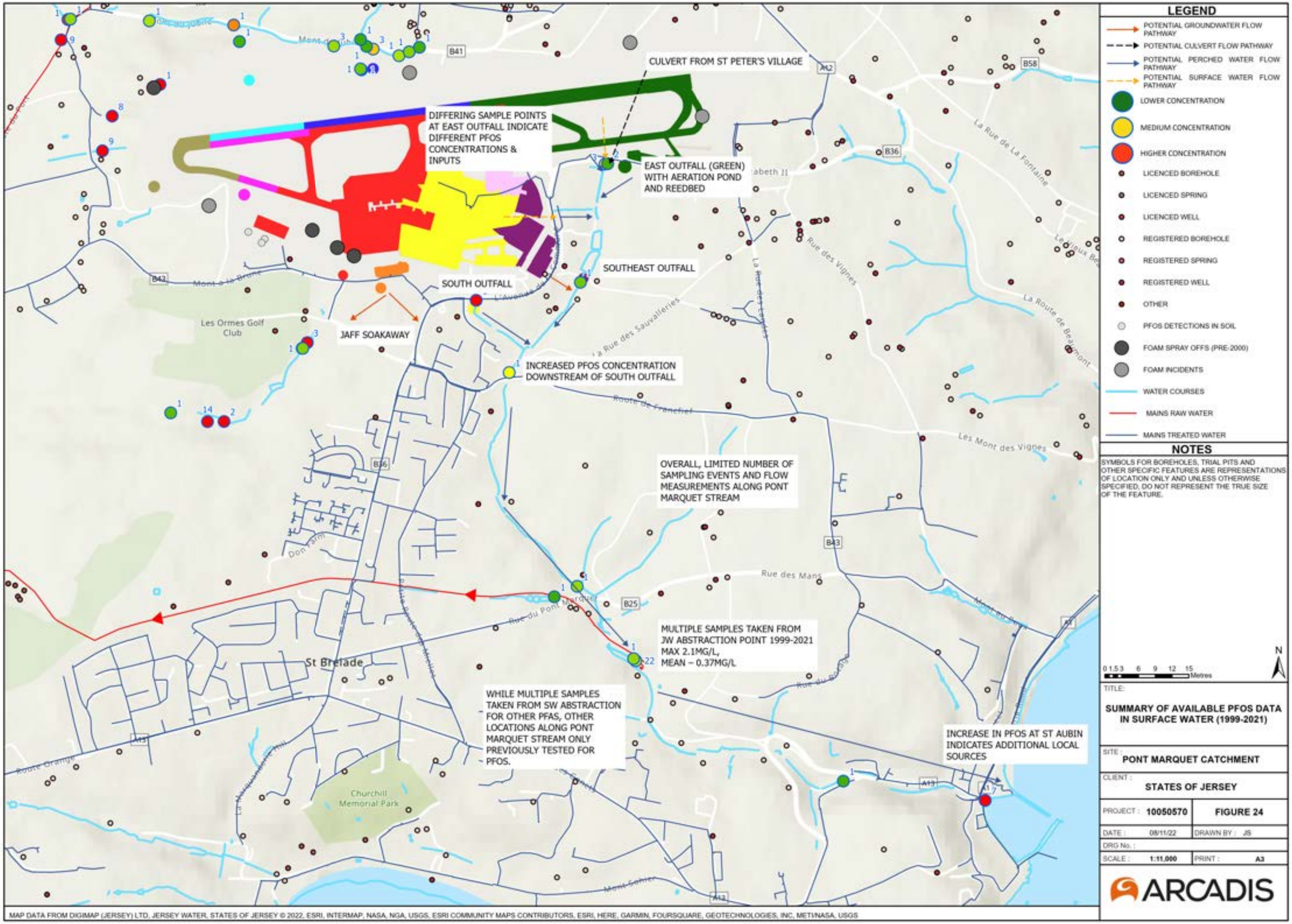
LEGEND
POTENTIAL GROUNDWATER FLOW PATHWAY
POTENTIAL CULVERT FLOW PATHWAY
POTENTIAL PERCHED WATER FLOW PATHWAY
POTENTIAL SURFACE WATER FLOW PATHWAY
LOWER CONCENTRATION
MEDIUM CONCENTRATION
HIGHER CONCENTRATION
LICENCED BOREHOLE
LICENCED SPRING
LICENCED WELL
REGISTERED BOREHOLE
REGISTERED SPRING
REGISTERED WELL
OTHER
PFOS DETECTIONS IN SOIL
FOAM SPRAY OFFS (PRE-2000)
FOAM INCIDENTS
WATER COURSES
MAINS RAW WATER
MAINS TREATED WATER
NOTES
SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.
CULVERT FROM ST PETER'S VILLAGE
DIFFERING SAMPLE POINTS AT EAST OUTFALL INDICATE DIFFERENT PFOS CONCENTRATIONS & INPUTS
EAST OUTFALL (GREEN) WITH AERATION POND AND REEDBED
SOUTHEAST OUTFALL
SOUTH OUTFALL
JAFF SOAKAWAY
INCREASED PFOS CONCENTRATION DOWNSTREAM OF SOUTH OUTFALL
OVERALL, LIMITED NUMBER OF SAMPLING EVENTS AND FLOW MEASUREMENTS ALONG PONT MARQUET STREAM
MULTIPLE SAMPLES TAKEN FROM JW ABSTRACTION POINT 1999-2021 MAX 2.1MG/L, MEAN – 0.37MG/L
WHILE MULTIPLE SAMPLES TAKEN FROM SW ABSTRACTION FOR OTHER PFAS, OTHER LOCATIONS ALONG PONT MARQUET STREAM ONLY PREVIOUSLY TESTED FOR PFOS.
INCREASE IN PFOS AT ST AUBIN INDICATES ADDITIONAL LOCAL SOURCES
Les Ormes Golf Club
St Brelade
Churchill Memorial Park
B41
B42
B58
B36
B43
B25
A12
A13
A1
La Rue de La Fontaine
La Route de Beaumont
Rue des Vignes
La Rue des Sauvalleries
Route de Francfief
Les Mont des Vignes
Rue des Mans
Rue du Pont Marquet
Mont à la Brune
Route Orange
Mont Sohier
0 1.5 3 6 9 12 15 Metres
N
TITLE:
SUMMARY OF AVAILABLE PFOS DATA IN SURFACE WATER (1999-2021)
SITE:
PONT MARQUET CATCHMENT
CLIENT:
STATES OF JERSEY
PROJECT: 10050570
FIGURE 24
DATE: 08/11/22
DRAWN BY: JS
DRG No.:
SCALE: 1:11,000
PRINT: A3
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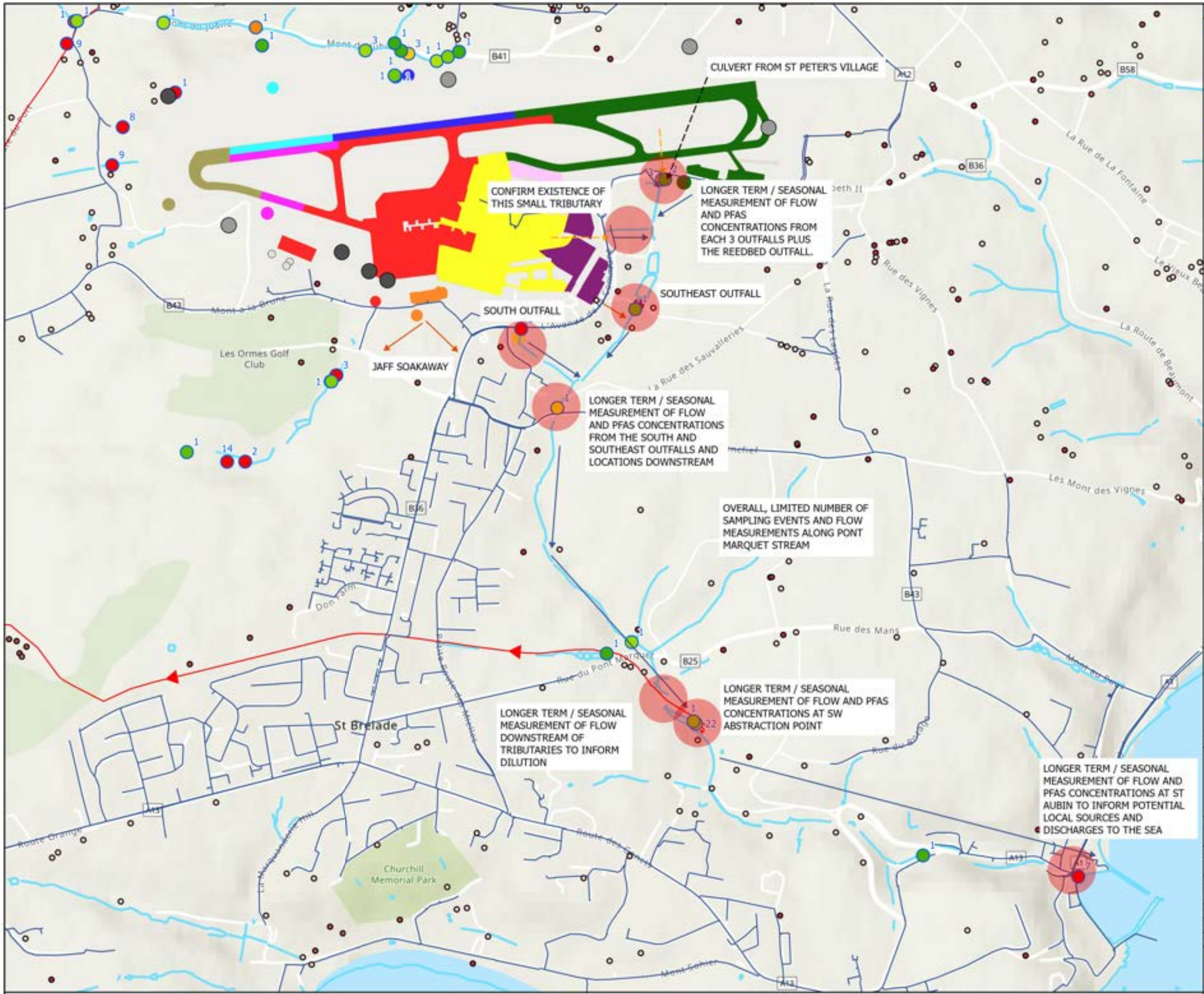

LEGEND

- POTENTIAL GROUNDWATER FLOW PATHWAY
- POTENTIAL CULVERT FLOW PATHWAY
- POTENTIAL PERCHED WATER FLOW PATHWAY
- POTENTIAL SURFACE WATER FLOW PATHWAY
- LOWER CONCENTRATION
- MEDIUM CONCENTRATION
- HIGHER CONCENTRATION
- LICENCED BOREHOLE
- LICENCED SPRING
- LICENCED WELL
- REGISTERED BOREHOLE
- REGISTERED SPRING
- REGISTERED WELL
- OTHER
- PFOS DETECTIONS IN SOIL
- FOAM SPRAY OFFS (PRE-2000)
- FOAM INCIDENTS
- WATER COURSES
- MAINS RAW WATER
- MAINS TREATED WATER

NOTES

SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.

0 1.5 3 6 9 12 15 Metres

N

TITLE: **SPATIAL DATA GAPS FOR PFOS IN SURFACE WATER**

SITE: **PONT MARQUET CATCHMENT**

CLIENT: **STATES OF JERSEY**

PROJECT:	10050570	FIGURE 25	
DATE:	08/11/22	DRAWN BY:	JS
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SCALE:	1:11,000	PRINT:	A3

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Appendix D

Table 1

Source	Pathway	Receptor	Severity of Hazard	Likelihood of Occurrence	Preliminary Risk Rating	Comment
St Ouen's Bay and Pont Marquet Catchment						
S1. Residual PFAS impacts within unsaturated soils beneath the FTA associated with historical firefighting foam usage. **S2.** Historical PFAS impacts within unsaturated soils across Jersey Airport associated within previous firefighting foam usage, spillages and soil movements	**P1.** Vertical migration of PFAS through unsaturated soils to perched water and underlying groundwater via soil leaching associated with historical soil impacts and soakaways	**R4.** Groundwater within the Jersey Shale Formation	Mild	High	Medium	Key pathway for PFAS soil impacts to reach sensitive receptors although Jersey Shale itself is not considered as sensitive a receptor as the Blown Sand Aquifer or surface water features.
	P2. Lateral migration of PFAS within perched water to identified surface water receptors e.g. as springs	**R5.** Surface water – water filled pits, outfall drains and streams	Mild	Likely	Low	Difficult to quanitify severity however the presence of Made Ground underlying the majority of the aiport plateau and presence of springs indicates the likelihood for a perched water pathway to be active
	P5. Surface Water Runoff	**R5.** Surface water – water filled pits, outfall drains and streams	Minor	Likely	Low	While airport plateau is surrounded by steep slopes, springs and streams the majority of rainfall on the airport is effectively captured and managed by the airports drainage system in order to ensure safe operation.
S3. PFAS contamination within saturated soils and groundwater	**P3.** Vertical and lateral migration of PFAS within groundwater to identified surface water receptors (including inland freshwater and the coastal marine environments) and groundwater abstractions	**R1.** Jersey residents consuming mains public water supply – a blend of sources which only in exceptional circumstances may contain water abstracted via boreholes within the St Ouen's Bay Blown Sand aquifer and via the surface water abstraction from the Pont Marquet stream, when Jersey Water are certain that water quality standards would be met	Mild	High	Medium	Current water management and treament practices undertaken by Jersey Water ensure that PFAS concentrations are maintained below global standards. Potential future changes to abstraction regime and standards to be further assessed in Phase 2.
		R2. Occupants of nearby residential properties consuming abstracted groundwater	Medium	High	High	PFAS contamination identified within mulitple boreholes and private water supplies above global standards with most residents moved to public mains water.
		R3. Groundwater within the St Ouen's Bay Blown Sand aquifer **R5.** Surface water – water filled pits, outfall drains and streams	Medium	High	High	Concentrations of PFAS detected within the Blown Sand aquifer and surface water features constituting a deterioration in water quality and impact on the amenity value of those resources.
		R4. Groundwater within the Jersey Shale Formation	Mild	High	Medium	Elevated PFAS concentrations identified within the Jersey Shale representing a key pathway to the more sensitive Blown Sand aquifer and surface water receptors although Jersey Shale itself is not considered as senstiive or as high amentity value.
		R6. Surface water – coastal marine environment	Minor	High	Low	PFAS mass flux to the coastal environment very likely to be occurring although flux likley decreasing over time and no PFAS detetced within marine biota to date.
	P4. Preferential pathways associated with airport drainage including the discharge of PFAS within stormwater to identified surface water receptors via drainage outfalls	**R5.** Surface water – water filled pits, outfall drains and streams	Medium	High	High	Highest PFOS detection within East Outfall and PFAS detected downstream at Jersey Water's abstraction. Eleavted PFAS concentrations within other streams receving stormwater from drainage outfalls.
	P6. Lateral migration of PFAS within surface water including streams, tributaries and ponds	**R1.** Jersey residents consuming mains public water supply – a blend of sources which only in exceptional circumstances may contain water abstracted via boreholes within the St Ouen's Bay Blown Sand aquifer and via the surface water abstraction from the Pont Marquet stream, when Jersey Water are certain that water quality standards would be met	Mild	High	Medium	Current water management and treament practices undertaken by Jersey Water ensure that PFAS concentrations are maintained below global standards. Potential future changes to abstraction regime and standards to be further assessed in Phase 2.
		R6. Surface water – coastal marine environment	Minor	High	Low	PFAS mass flux to the coastal environment very likely to be occurring although flux likely decreasing over time and no PFAS detected within marine biota to date.
	P7. Abstracted groundwater used for crop and food irrigation and livestock feeding and direct plant uptake	**R7.** Consumers of crops, foodstuffs and livestock where there is a potential for PFAS impacted soil, biosolids, irrigation water or feed water to have been involved	Minor	Likely	Low	Previous analysis in 1998 and 2000 of potatoes did not detect PFAS. Potential for current analytical techniques to detect a wider range of PFAS at lower detection limits. Review of all potential exposure routes associated with crops & livestock has not been undertaken.
	P3. Vertical and lateral migration of PFAS within groundwater to identified surface water receptors (including inland freshwater and the coastal marine environments) and groundwater abstractions **P6.** Lateral migration of PFAS within surface water including streams, tributaries and ponds	**R8.** Ecological receptors including biota within inland freshwater and coastal marine environment	Minor	High	Low	Previous analysis in 2007, 2011 and 2012 did not detect PFAs in limpets or seaweed. Potential for current analytical techniques to detect a wider range of PFAS at lower detection limits. Review of all potential exposure routes associated with water biota has not been undertaken.
S4. Land spreading of biosolids within the catchments – exact locations currently unknown	**P7.** Abstracted groundwater used for crop and food irrigation and livestock feeding and direct plant uptake	**R7.** Consumers of crops, foodstuffs and livestock where there is a potential for PFAS impacted soil, biosolids, irrigation water or feed water to have been involved	Minor	Likely	Low	Previous analysis in 1998 and 2000 of potatoes did not detect PFAS. Potential for current analytical techniques to detect a wider range of PFAS at lower detection limits. Review of all potential exposure routes associated with crops & livestock has not been undertaken.
S5. Historical landfills within St Ouen's Bay - deposited waste types and age currently unknown	**P1.** Vertical migration of PFAS through unsaturated soils to perched water and underlying groundwater via soil leaching associated with historical soil impacts and soakaways	**R2.** Occupants of nearby residential properties consuming abstracted groundwater **R3.** Groundwater within the St Ouen's Bay Blown Sand aquifer **R5.** Surface water – water filled pits, outfall drains and streams	Minor	Low	Low	While waste types and volumes unknown it is considered unlikely that these landfills represent a significant PFAS source to the Blown Sand aquifer or local surface water features based on PFAS distribution observed.
S6. Localised PFAS sources / discharges in the vicinity of St Aubin	Unknown. Potential industrial and/or urban wastewater discharges.	**R8.** Ecological receptors including biota within inland freshwater and coastal marine environment	Minor	High	Low	Previous analysis in 2007, 2011 and 2012 did not detect PFAs in limpets or seaweed. Potential for current analytical techniques to detect a wider range of PFAS at lower detection limits. Review of all potential exposure routes associated with water biota has not been undertaken.

Table 2 - PFAS Standards in Surface Water – Europe and UK

Country	State or Jurisdiction (if applicable)	Compound	Media	Type	Value	Combined with other PFASs?	Additive PFASs	Units	Author	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
Germany	Bavaria	6:2 FtS	Surface Water	PNEC aquatic	870	No	N/A	µg/L	Bayerisches Landesamt für Umwelt (LfU)	2017	Proposed	3° Tertiary
Germany	Bavaria	PFHxA	Surface Water	PNEC aquatic	1000	No	N/A	µg/L	Bayerisches Landesamt für Umwelt (LfU)	2017	Proposed	3° Tertiary
Netherlands	N/A	PFBA	Surface Water	AA-EQS	1000	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFPeA	Surface Water	AA-EQS	300	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFHxA	Surface Water	AA-EQS	400	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFHpA	Surface Water	AA-EQS	0.9	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFOA	Surface Water	AA-EQS	0.3	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFNA	Surface Water	AA-EQS	0.007	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFDA	Surface Water	AA-EQS	0.003	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFUnDA	Surface Water	AA-EQS	0.001	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFDoDA	Surface Water	AA-EQS	0.0004	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFTrDA	Surface Water	AA-EQS	0.0009	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFTeDA	Surface Water	AA-EQS	0.02	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFHxDA	Surface Water	AA-EQS	-	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFODA	Surface Water	AA-EQS	-	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFBS	Surface Water	AA-EQS	3000	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFPeS	Surface Water	AA-EQS	1	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFHxS	Surface Water	AA-EQS	0.2	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFHpS	Surface Water	AA-EQS	0.02	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFOS	Surface Water	AA-EQS	0.007	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFDS	Surface Water	AA-EQS	0.004	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	GenX	Surface Water	AA-EQS	10	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	ADONA	Surface Water	AA-EQS	-	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	6:2 FTOH	Surface Water	AA-EQS	40	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	8:2 FTOH	Surface Water	AA-EQS	2	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	4:2 FTS	Surface Water	AA-EQS	300	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	6:2 FTS	Surface Water	AA-EQS	0.9	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	8:2 FTS	Surface Water	AA-EQS	0.007	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	PFOSA	Surface Water	AA-EQS	0.007	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	EtFOSAA	Surface Water	AA-EQS	0.007	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
Netherlands	N/A	MeFOSAA	Surface Water	AA-EQS	0.007	Yes	All	ng/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2022	Proposed	3° Tertiary
European Union (EU)	EU Member States	24 PFAS Compounds	Surface Water	Proposed Environmental Quality Standard (EQS)	0.0044	Yes	Sum of 24 PFAS compound concentrations adjusted by a Relative Potency Factor (RPF)	µg/L	European Commission (EC)	2022	Proposed	3° Tertiary
UK and EU Countries	N/A	PFOS	Surface Water	AA-EQS Inland surface waters	0.00065	No	N/A	µg/L	EU Water Framework Directive (Directive 2013/39/EU) and UK Regulations 2017	2013	Promulgated	1° Primary
UK and EU Countries	N/A	PFOS	Surface Water	AA-EQS Other surface waters	0.00013	No	N/A	µg/L	EU Water Framework Directive (Directive 2013/39/EU) and UK Regulations 2017	2013	Promulgated	1° Primary
UK and EU Countries	N/A	PFOS	Surface Water	MAC-EQS Inland surface waters	36	No	N/A	µg/L	EU Water Framework Directive (Directive 2013/39/EU) and UK Regulations 2017	2013	Promulgated	1° Primary
UK and EU Countries	N/A	PFOS	Surface Water	MAC-EQS Other surface waters	7.2	No	N/A	µg/L	EU Water Framework Directive (Directive 2013/39/EU) and UK Regulations 2017	2013	Promulgated	1° Primary
UK	N/A	PFOS	Surface Water	Alterntive Empirical AA-EQS	0.003	No	N/A	µg/L	UK Environment Agency (EA)	2019	Empirically Derived Threshold	2° Secondary

Table 3 - PFAS Standards in Surface Water – North America

Country	State or Jurisdiction (if applicable)	Compound	Media [a]	Type	Value	Combined with other PFASs?	Additive PFASs	Units	Author	Current or Outdated?	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
USA	Colorado	Multiple PFAS	Surface Water	Narrative Policy Translation Levels	0.07	Yes	PFOA, PFOS, PFNA, NEtFOSAA, NMeFoSAA, PFOSA, 8:2 FTS	µg/L	Colorado Water Quality Control Commission	Current	01/07/2020	Promulgated	3° Tertiary
USA	Colorado	PFBS	Surface Water	Narrative Policy Translation Levels	400	No	N/A	µg/L	Colorado Water Quality Control Commission	Current	2020	Promulgated	3° Tertiary
USA	Oregon	PFHpA	Surface Water	Health Advisory Level	0.3	No		µg/L	ECOS (PFAS Caucus)	Current	Mar-22	Promulgated	3° Tertiary
USA	New Hampshire	PFHxS	Surface Water	Surface Water Quality Standard	0.018	No	N/A	µg/L	New Hampshire Deparment of Environmental Services	Current	N/A	Proposed	3° Tertiary
USA	Oregon	PFNA	Surface Water	Health Advisory Level	1	No		µg/L	ECOS (PFAS Caucus)	Current	Mar-22	Promulgated	3° Tertiary
USA	Federal (U.S.) - EPA	PFOA	Surface Water	Aquatic Life Ambient Water Quality Criteria	49000 CCC / 940 CMC	No	N/A	µg/L	U.S. Environmental Protection Agency (EPA)	Current	2022	Proposed	2° Secondary
USA	New York	PFOA	Surface Water	Guidance Value: Human Health	0.0067	No	n/a	µg/L	New York State Department of Environmental Conservation (NYSDEC)	Current	14/10/2021	Proposed	3° Tertiary
USA	Texas	PFOA	Surface Water	Saltwater Chronic Benchmark	0.00029	No	N/A	µg/L	Texas Commission on Environmental Quality	Current	31/08/2020	Promulgated	3° Tertiary
USA	Federal (U.S.) - EPA	PFOS	Surface Water	Aquatic Life Ambient Water Quality Criteria	3000 CCC / 8.4 CMC	No	N/A	µg/L	U.S. Environmental Protection Agency (EPA)	Current	2022	Proposed	2° Secondary
USA	Minnesota	PFOS	Surface Water	Site-Specific Water Quality Criteria: Chronic Criteria (Class 1/2A or Class 1/2Bd surface water uses)	0.00005	No	N/A	µg/L	Minnesota Pollution Control Agency	Current	01/12/2020	Proposed	3° Tertiary
USA	Minnesota	PFOS	Surface Water	Site-Specific Water Quality Criteria: Chronic Criteria (Class 2B/2D surface water uses)	0.00005	No	N/A	µg/L	Minnesota Pollution Control Agency	Current	01/12/2020	Proposed	3° Tertiary

Table 4 - PFAS Standards in Surface Water – Australia

Region	Country	State or Jurisdiction (if applicable)	Compound	Media	Type	Value	Combined with other PFASs?	Additive PFASs	Units	Author	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
Australia	Australia	Federal (Airports)	6:2 FTS	Surface water	Health Interim Screening Levels (HISLs) (consumption of fish)	0.0065	No	N/A	µg/L	Department of Industrial and Regional Development and Airservices	Jun-15	Proposed	3° Tertiary
Australia	Australia	Federal (Airports)	8:2 FtS	Surface water	Ecological Investigation Levels (EILs) (toxicity effect on aquatic organisms)	2900	Yes	PFOA and 8:2 FtS	µg/L	Department of Industrial and Regional Development and Airservices	Jun-15	Proposed	3° Tertiary
Australia	Australia	Federal (Airports)	8:2 FtS	Surface water	Health Interim Screening Levels (HISLs) (consumption of fish)	0.3	Yes	PFOA and 8:2 FtS	µg/L	Department of Industrial and Regional Development and Airservices	Jun-15	Proposed	3° Tertiary
Australia	Australia	New South Wales	Other	Surface water	Trigger Point 1 Elevated contamination	10	Yes	all PFAS analytes measured	µg/L	EnRisks to New South Wales EPA	Feb-16	Proposed	3° Tertiary
Australia	Australia	New South Wales	Other	Surface water	Trigger Point 2 Current Screening guideline	0.1	Yes	all PFAS analytes measured	µg/L	EnRisks to New South Wales EPA	Feb-16	Proposed	3° Tertiary
Australia	Australia	New South Wales	Other	Surface water	Trigger Point 3 Low level of contamination	0.05	Yes	all PFAS analytes measured	µg/L	EnRisks to New South Wales EPA	Feb-16	Proposed	3° Tertiary
Australia	Australia	N/A	PFHxS	Fresh water	Aquaculture	0.021	Yes	PFOS and PFHxS	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFHxS	Fresh water	Health Screening Level (HSL) (fish consumption)	0.021	Yes	PFOS and PFHxS	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFHxS	Fresh water	Ecological - high conservation value systems (99%)	0.00023	Yes	PFOS and PFHxS	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFHxS	Fresh water	Ecological - highly disturbed systems (90%)	2	Yes	PFOS and PFHxS	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFHxS	Fresh water	Ecological - highly disturbed systems (90%)	31	Yes	PFOS and PFHxS	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFHxS	Fresh water	Ecological - slightly to moderately disturbed systems (95%)	0.13	Yes	PFOS and PFHxS	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFHxS	Non-potable and recreational uses	Non-potable and recreational uses	0.5	Yes	PFOS and PFHxS	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFHxS	Recreational water	Recreational water	0.7	Yes	PFOS and PFHxS	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	3° Tertiary
Australia	Australia	N/A	PFHxS	Recreational water	Recreational water	700	Yes	PFOS and PFHxS	µg/L	Department of Health	Apr-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFHxS	Recreational water	Recreational water	2	Yes	PFOS and PFHxS	µg/L	NHMRC	Aug-18	Proposed	3° Tertiary
Australia	Australia	N/A	PFHxS	Recreational water	Recreational water	5	Yes	PFOS and PFHxS	µg/L	EnHealth	Jun-16	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Fresh water	80% species protection - highly disturbed systems	1824	No	N/A	µg/L	Department of Environment and Energy	Oct-16	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Fresh water	90% species protection - highly disturbed systems	630	No	N/A	µg/L	Department of Environment and Energy	Oct-16	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Fresh water	95% species protection - slightly to moderately disturbed systems	220	No	N/A	µg/L	Department of Environment and Energy	Oct-16	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Fresh water	99% species protection - high conservation value systems	19	No	N/A	µg/L	Department of Environment and Energy	Oct-16	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Fresh water	High conservation value systems (99%)	19	No	N/A	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	2° Secondary
Australia	Australia	N/A	PFOA	Fresh water	Highly disturbed systems (80%)	1824	No	N/A	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	2° Secondary
Australia	Australia	N/A	PFOA	Fresh water	Highly disturbed systems (90%)	632	No	N/A	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	2° Secondary
Australia	Australia	N/A	PFOA	Fresh water	Slightly to moderately disturbed systems (95%)	220	No	N/A	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	2° Secondary
Australia	Australia	N/A	PFOA	Fresh water	Aquaculture	0.21	No	N/A	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Fresh water	Ecological Screening Levels (ESLs) (80%)	1824	No	N/A	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Fresh water	Ecological Screening Levels (ESLs) (90%)	632	No	N/A	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Fresh water	Ecological Screening Levels (ESLs) (95%)	220	No	N/A	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Fresh water	Ecological Screening Levels (ESLs) (99%)	19	No	N/A	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Fresh water	Health Screening Level (HSL) (fish consumption)	0.21	No	N/A	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFOA	Fresh water	Ecological - high conservation value systems (99%)	19	No	N/A	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFOA	Fresh water	Ecological - highly disturbed systems (90%)	632	No	N/A	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFOA	Fresh water	Ecological - highly disturbed systems (90%)	1824	No	N/A	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFOA	Fresh water	Ecological - slightly to moderately disturbed systems (95%)	220	No	N/A	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFOA	Non-potable and recreational uses	Non-potable and recreational uses	5	No	N/A	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Recreational water	Recreational water	5.6	No	N/A	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	3° Tertiary
Australia	Australia	N/A	PFOA	Recreational water	Recreational water	5.6	No	N/A	µg/L	Department of Health	Apr-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Recreational water	Recreational water	14	No		µg/L	NHMRC	Aug-18	Proposed	3° Tertiary
Australia	Australia	N/A	PFOA	Recreational water	Recreational water	50	No	N/A	µg/L	EnHealth	Jun-16	Proposed	3° Tertiary
Australia	Australia	Federal (Airports)	PFOA	Surface water	Ecological Investigation Levels (EILs) (toxicity effect on aquatic organisms)	2900	Yes	PFOA and 8:2 FtS	µg/L	Department of Industrial and Regional Development and Airservices	Jun-15	Proposed	3° Tertiary
Australia	Australia	Federal (Airports)	PFOA	Surface water	Health Interim Screening Levels (HISLs) (consumption of fish)	0.3	Yes	PFOA and 8:2 FtS	µg/L	Department of Industrial and Regional Development and Airservices	Jun-15	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Fresh water	80% species protection - highly disturbed systems	31	No	N/A	µg/L	Department of Environment and Energy	Oct-16	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Fresh water	90% species protection - highly disturbed systems	2	No	N/A	µg/L	Department of Environment and Energy	Oct-16	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Fresh water	95% species protection - slightly to moderately disturbed systems	0.13	No	N/A	µg/L	Department of Environment and Energy	Oct-16	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Fresh water	99% species protection - high conservation value systems	0.00023	No	N/A	µg/L	Department of Environment and Energy	Oct-16	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Fresh water	High conservation value systems (99%)	0.00023	No	N/A	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	2° Secondary
Australia	Australia	N/A	PFOS	Fresh water	Highly disturbed systems (80%)	31	No	N/A	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	2° Secondary

Table 4 - PFAS Standards in Surface Water – Australia

Region	Country	State or Jurisdiction (if applicable)	Compound	Media	Type	Value	Combined with other PFASs?	Additive PFASs	Units	Author	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
Australia	Australia	N/A	PFOS	Fresh water	Highly disturbed systems (90%)	2	No	N/A	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	2° Secondary
Australia	Australia	N/A	PFOS	Fresh water	Slightly to moderately disturbed systems (95%)	0.13	No	N/A	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	2° Secondary
Australia	Australia	N/A	PFOS	Fresh water	Aquaculture	0.021	Yes	PFOS and PFHxS	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Fresh water	Ecological Screening Levels (ESLs) (90%)	2	No	N/A	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Fresh water	Ecological Screening Levels (ESLs) (99%)	0.00023	No	N/A	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Fresh water	Ecological Screening Levels (ESLs) (80%)	31	No	N/A	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Fresh water	Ecological Screening Levels (ESLs) (95%)	0.13	No	N/A	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Fresh water	Health Screening Level (HSL) (fish consumption)	0.021	Yes	PFOS and PFHxS	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFOS	Fresh water	Ecological - high conservation value systems (99%)	0.00023	Yes	PFOS and PFHxS	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFOS	Fresh water	Ecological - highly disturbed systems (90%)	2	Yes	PFOS and PFHxS	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFOS	Fresh water	Ecological - highly disturbed systems (90%)	31	Yes	PFOS and PFHxS	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFOS	Fresh water	Ecological - slightly to moderately disturbed systems (95%)	0.13	Yes	PFOS and PFHxS	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	Western Australia	PFOS	Non-potable and recreational uses	Non-potable and recreational uses	0.5	Yes	PFOS and PFHxS	µg/L	Department of Environment Regulation	Jan-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Recreational water	Recreational water	0.7	Yes	PFOS and PFHxS	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	3° Tertiary
Australia	Australia	N/A	PFOS	Recreational water	Recreational water	700	Yes	PFOS and PFHxS	µg/L	Department of Health	Apr-17	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Recreational water	Recreational water	2	Yes	PFOS and PFHxS	µg/L	NHMRC	Aug-18	Proposed	3° Tertiary
Australia	Australia	N/A	PFOS	Recreational water	Recreational water	5	Yes	PFOS and PFHxS	µg/L	EnHealth	Jun-16	Proposed	3° Tertiary
Australia	Australia	Federal (Airports)	PFOS	Surface water	Ecological Investigation Levels (EILs) (toxicity effect on aquatic organisms)	6.66	No	N/A	µg/L	Department of Industrial and Regional Development and Airservices	Jun-15	Proposed	3° Tertiary
Australia	Australia	Federal (Airports)	PFOS	Surface water	Health Interim Screening Levels (HISLs) (consumption of fish)	0.00065	No	N/A	µg/L	Department of Industrial and Regional Development and Airservices	Jun-15	Proposed	3° Tertiary

Table 5 - PFAS Standards in Drinking Water – Europe and UK

Country	State or Jurisdiction (if applicable)	Compound	Media	Type	Value	Combined with other PFAS?	Additive PFASs	Units	Author	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
Denmark	N/A	Sum PFAS	Drinking Water	Health Based Value	0.1	Yes	PFOS, PFOA, PFOSA, PFBS, PFBA, PFPeA, PFHxA, PFHpA, PFNA, PFDA, PFHxS, 6:2 FtS	µg/L	Danish Ministry of the Environment	2015	Promulgated	2° Secondary
European Union Member States	N/A	Sum PFAS	Drinking Water	Drinking Water Limit Value	0.1	Yes	PFBA, PFPA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTrDA, PFBS, PFPS, PFHxS, PFHpS, PFOS, PFNS, PFDS, PFUnDS, PFDoDS, PFTrDS	µg/L	European Parliament and Council of the European Union	Jan-21	Promulgated	1° Primary
European Union Member States	N/A	Total PFAS	Drinking Water	Drinking Water Limit Value	0.5	Yes	Total PFAS (e.g. by TOP Assay or TOF)	µg/L	European Parliament and Council of the European Union	Jan-21	Promulgated	1° Primary
Germany	N/A	PFBA	Drinking Water	Health-Related Indication Value (Trinkwasser-Leitwert)	10	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFPeA	Drinking Water	Health Precautionary Value (Gesundheitlicher Orientierungwert)	3	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFHxA	Drinking Water	Health-Related Indication Value (Trinkwasser-Leitwert)	6	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFHpA	Drinking Water	Health Precautionary Value (Gesundheitlicher Orientierungwert)	0.3	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFOA	Drinking Water	Health-Related Indication Value (Trinkwasser-Leitwert)	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFNA	Drinking Water	Health-Related Indication Value (Trinkwasser-Leitwert)	0.06	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFDA	Drinking Water	Health Precautionary Value (Gesundheitlicher Orientierungwert)	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFBS	Drinking Water	Health-Related Indication Value (Trinkwasser-Leitwert)	6	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFHxS	Drinking Water	Health-Related Indication Value (Trinkwasser-Leitwert)	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFHpS	Drinking Water	Health Precautionary Value (Gesundheitlicher Orientierungwert)	0.3	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFOS	Drinking Water	Health-Related Indication Value (Trinkwasser-Leitwert)	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	6:2 FtS	Drinking Water	Health Precautionary Value (Gesundheitlicher Orientierungwert)	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFOSA	Drinking Water	Health Precautionary Value (Gesundheitlicher Orientierungwert)	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, nukleare Sicherheid und Verbraucherschutz	2022	Promulgated	2° Secondary
Switzerland	N/A	PFHxS	Drinking Water	Maximum tolerable drinking water level	0.0003	No	N/A	µg/L	Das Eidgenössische Departement des Innern	2017	Promulgated	2° Secondary
Switzerland	N/A	PFOA	Drinking Water	Maximum tolerable drinking water level	0.0005	No	N/A	µg/L	Das Eidgenössische Departement des Innern	2017	Promulgated	2° Secondary
Switzerland	N/A	PFOS	Drinking Water	Maximum tolerable drinking water level	0.0003	No	N/A	µg/L	Das Eidgenössische Departement des Innern	2017	Promulgated	2° Secondary
UK	N/A	PFOA	Drinking Water	Tier 1 - Guidance Value (actions if below)	0.01	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	PFOA	Drinking Water	Tier 2 - Guidance Value (actions if below)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	PFOA	Drinking Water	Tier 3 - Guidance Value (actions if above)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	PFOS	Drinking Water	Tier 1 - Guidance Value (actions if below)	0.01	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	PFOS	Drinking Water	Tier 2 - Guidance Value (actions if below)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	PFOS	Drinking Water	Tier 3 - Guidance Value (actions if above)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	47 PFAS Compounds	Drinking Water	Tier 1 - Guidance Value (actions if below)	0.01	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	47 PFAS Compounds	Drinking Water	Tier 2 - Guidance Value (actions if below)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	47 PFAS Compounds	Drinking Water	Tier 3 - Guidance Value (actions if above)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary

Table 6 - PFAS Standards in Drinking Water – North America

Country	State or Jurisdiction (if applicable)	Compound	Media [a]	Type	Value	Combined with other PFASs?	Additive PFASs	Units	Author	Current or Outdated?	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
USA	Hawaii	GenX	Drinking Water	Drinking Water/Risk-Based Action Levels	0.0016	No	N/A	µg/L	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Federal (U.S.) - EPA	GenX	Drinking Water	Maximum Contaminant Level (MCL)	1	Yes	PFNA, PFHxS, PFBS	Hazard Index	U.S. Environmental Protection Agency (EPA)	Current	14/03/2023	Proposed	3° Tertiary
USA	Hawaii	PFBA	Drinking Water	Drinking Water/Risk-Based Action Levels	0.00076	No	N/A	µg/L	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Minnesota	PFBA	Drinking Water	Health Based Value (HBV - chronic and subchronic)	7	No	n/a	µg/L	Minnesota Department of Health (MDH)	Current	03/05/2018	Promulgated	3° Tertiary
USA	Washington	PFBS	Drinking Water	State Action Level (SAL)	0.345	No	N/A	µg/L	Washington State Dept. of Health	Current	1/1/2022	Promulgated	3° Tertiary
USA	Federal (U.S.) - EPA	PFBS	Drinking Water	Maximum Contaminant Level (MCL)	1	Yes	PFNA, PFHxS, HFPO-DA	Hazard Index	U.S. Environmental Protection Agency (EPA)	Current	14/03/2023	Proposed	3° Tertiary
USA	Maine	PFDA	Drinking Water	Interim Drinking Water Standard	0.02	Yes	PFOA, PFOS, PFHpA, PFNA, PFHxS, PFDA	µg/L	Maine Department of Health and Human Services	Current	21/06/2021	Promulgated	3° Tertiary
USA	Hawaii	PFDoDA	Drinking Water	Drinking Water/Risk-Based Action Levels	0.013	No	N/A	µg/L	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Hawaii	PFDS	Drinking Water	Drinking Water/Risk-Based Action Levels	0.02	No	N/A	µg/L	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Maine	PFHpA	Drinking Water	Interim Drinking Water Standard	0.02	Yes	PFOA, PFOS, PFHpA, PFNA, PFHxS, PFDA	µg/L	Maine Department of Health and Human Services	Current	21/06/2021	Promulgated	3° Tertiary
USA	Hawaii	PFHpS	Drinking Water	Drinking Water/Risk-Based Action Levels	0.02	No	N/A	µg/L	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Minnesota	PFHxA	Drinking Water	Health Based Value (HBV - chronic and subchronic)	0.2	No	n/a	µg/L	Minnesota Department of Health (MDH)	Current	12/15/2021	Promulgated	3° Tertiary
USA	New Hampshire	PFHxS	Drinking Water	Maximum Contaminant Level (MCL)	0.018	No	N/A	µg/L	New Hampshire Deparment of Environmental Services	Current	03/09/2020	Promulgated	3° Tertiary
USA	Federal (U.S.) - EPA	PFHxS	Drinking Water	Maximum Contaminant Level (MCL)	1	Yes	PFNA, PFBS, HFPO-DA	Hazard Index	U.S. Environmental Protection Agency (EPA)	Current	14/03/2023	Proposed	3° Tertiary
USA	Michigan	PFNA	Drinking Water	Maximum Contaminant Level (MCL)	0.006	No	n/a	µg/L	Michigan Department of Environment, Great Lakes, and Energy	Current	01/07/2020	Promulgated	3° Tertiary
USA	Federal (U.S.) - EPA	PFNA	Drinking Water	Maximum Contaminant Level (MCL)	1	Yes	PFHxS, PFBS, HFPO-DA	Hazard Index	U.S. Environmental Protection Agency (EPA)	Current	14/03/2023	Proposed	3° Tertiary
USA	Federal (U.S.) - DoD	PFOA	Drinking Water	Screening Level for RI Determination	0.04	No	N/A	µg/L	U.S. Department of Defense (DoD)	Current	2021	Promulgated	2° Secondary
USA	Federal (U.S.) - DoD	PFOA	Drinking Water	Screening Level for RI Determination	0.4	No	N/A	µg/L	U.S. Department of Defense (DoD)	Current	2021	Promulgated	2° Secondary
USA	Federal (U.S.) - EPA	PFOA	Drinking Water	Health Advisory	0.07	Yes	PFOA, PFOS	µg/L	U.S. Environmental Protection Agency (EPA)	Current	01/05/2016	Promulgated	2° Secondary
USA	Federal (U.S.) - EPA	PFOA	Drinking Water	Maximum Contaminant Level (MCL)	0.004	No	N/A	µg/L	U.S. Environmental Protection Agency (EPA)	Current	14/03/2023	Proposed	3° Tertiary
USA	Federal (U.S.) - EPA	PFOA	Drinking Water	U.S. EPA Risk-Based Screening Level (RSL), Tapwater	0.006	No	N/A	µg/L	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	3° Tertiary
USA	Illinois	PFOA	Drinking Water	Health Advisory	0.002	No	N/A	µg/L	Illinois EPA	Current	28/01/2021	Promulgated	3° Tertiary
USA	California	PFOS	Drinking Water	Notification Level	0.0065	No	N/A	µg/L	California Dept. of Drinking Water (DDW)	Current	01/08/2019	Promulgated	3° Tertiary
USA	Federal (U.S.) - DoD	PFOS	Drinking Water	Screening Level for RI Determination	0.04	No	N/A	µg/L	U.S. Department of Defense (DoD)	Current	2021	Promulgated	2° Secondary
USA	Federal (U.S.) - DoD	PFOS	Drinking Water	Screening Level for RI Determination	0.4	No	N/A	µg/L	U.S. Department of Defense (DoD)	Current	2021	Promulgated	2° Secondary
USA	Federal (U.S.) - EPA	PFOS	Drinking Water	Health Advisory	0.07	Yes	PFOA, PFOS	µg/L	U.S. Environmental Protection Agency (EPA)	Current	01/05/2016	Promulgated	2° Secondary
USA	Federal (U.S.) - EPA	PFOS	Drinking Water	Maximum Contaminant Level (MCL)	0.004	No	N/A	µg/L	U.S. Environmental Protection Agency (EPA)	Current	14/03/2023	Proposed	
USA	Federal (U.S.) - EPA	PFOS	Drinking Water	U.S. EPA Risk-Based Screening Level (RSL), Tapwater	0.004	No	N/A	µg/L	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	3° Tertiary
USA	Hawaii	PFOSA	Drinking Water	Drinking Water/Risk-Based Action Levels	0.024	No	N/A	µg/L	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Hawaii	PFPeA	Drinking Water	Drinking Water/Risk-Based Action Levels	0.008	No	N/A	µg/L	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Hawaii	PFTeDA	Drinking Water	Drinking Water/Risk-Based Action Levels	0.0013	No	N/A	µg/L	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Hawaii	PFTrDA	Drinking Water	Drinking Water/Risk-Based Action Levels	0.013	No	N/A	µg/L	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Hawaii	PFUnDA	Drinking Water	Drinking Water/Risk-Based Action Levels	0.01	No	N/A	µg/L	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary

Table 7 - PFAS Standards in Drinking Water – Australia

Country	State or Jurisdiction (if applicable)	Compound	Media	Type	Value	Combined with other PFASs?	Additive PFASs	Units	Author	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
Australia	Federal (Airports)	6:2 FTS	Drinking water	Drinking water	5	No	N/A	µg/L	Department of Industrial and Regional Development and Airservices	Jun-15	Proposed	3° Tertiary
Australia	Federal (Airports)	8:2 FtS	Drinking water	Drinking water	0.4	Yes	PFOA and 8:2 FtS	µg/L	Department of Industrial and Regional Development and Airservices	Jun-15	Proposed	3° Tertiary
Australia	N/A	PFHxS	Drinking water	Drinking water	0.07	Yes	PFOS and PFHxS	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	2° Secondary
Australia	N/A	PFOA	Drinking water	Drinking water	0.56	No	N/A	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	2° Secondary
Australia	N/A	PFOS	Drinking water	Drinking water	0.07	Yes	PFOS and PFHxS	µg/L	Heads of EPAs Australia and New Zealand (HEPA)	Jan-18	Promulgated	2° Secondary

Table 8 - PFAS Standards in Groundwater – Europe and UK

Country	State or Jurisdiction (if applicable)	Compound	Media	Type	Value	Combined with other PFAS?	Additive PFASs	Units	Author	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
Belgium	Flanders	sum PFAS	Groundwater	Remediation criterium	0.1	No	N/A	µg/L	OVAM	2022	Promulgated	Tertiary
Belgium	Flanders	PFAS-total	Groundwater	Remediation criterium	0.5	No	N/A	µg/L	OVAM	2022	Promulgated	Tertiary
Germany	Baden-Wurttemberg	PFOS	Groundwater	Threshold value	0.0001	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	PFOA	Groundwater	Threshold value	0.0001	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	6:2 FtS	Groundwater	Threshold value	0.0001	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	PFNA	Groundwater	Threshold value	0.00006	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	PFDA	Groundwater	Threshold value	0.0001	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	PFHpS	Groundwater	Threshold value	0.0003	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	PFHpA	Groundwater	Threshold value	0.0003	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	PFHxS	Groundwater	Threshold value	0.0001	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	PFHxA	Groundwater	Threshold value	0.006	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	PFPeA	Groundwater	Threshold value	0.003	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	PFBS	Groundwater	Threshold value	0.006	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	PFBA	Groundwater	Threshold value	0.01	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	PFOSA	Groundwater	Threshold value	0.0001	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	Baden-Wurttemberg	Other	Groundwater	Threshold value	0.001	No	N/A	µg/L	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	2018	Promulgated but regional not national value	2° Secondary
Germany	N/A	PFBA	Groundwater	Insignificance Threshold	10	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	PFPeA	Groundwater	Health Advisory Limit	3	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	PFHxA	Groundwater	Insignificance Threshold	6	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	PFHpA	Groundwater	Health Advisory Limit	0.3	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	PFOA	Groundwater	Insignificance Threshold	0.1	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	PFNA	Groundwater	Insignificance Threshold	0.06	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	PFDA	Groundwater	Health Advisory Limit	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	PFBS	Groundwater	Insignificance Threshold	6	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	PFHxS	Groundwater	Insignificance Threshold	0.1	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	PFHpS	Groundwater	Health Advisory Limit	0.3	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	PFOS	Groundwater	Insignificance Threshold	0.1	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	6:2 FTS	Groundwater	Health Advisory Limit	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	PFOSA	Groundwater	Health Advisory Limit	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Germany	N/A	Other PFAS with R1-(CF2)n-R2, and n>3	Groundwater	Health Advisory Limit	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	Tertiary
Netherlands	Gemeente Haarlemmermeer, Gemeente Amsterdam and Provincie Noord-Holland	PFOS	Groundwater	Not contaminated	0.00001	No	N/A	µg/L	Gemeente Haarlemmermeer	2019	Promulgated but regional not national value	2° Secondary
Netherlands	Gemeente Haarlemmermeer, Gemeente Amsterdam and Provincie Noord-Holland	PFOS	Groundwater	Contaminated - no remediation necessary	0.0047	No	N/A	µg/L	Gemeente Haarlemmermeer	2019	Promulgated but regional not national value	2° Secondary
Netherlands	Gemeente Haarlemmermeer, Gemeente Amsterdam and Provincie Noord-Holland	PFOS	Groundwater	Seriously contaminated - remediation necessary	>4.7	No	N/A	µg/L	Gemeente Haarlemmermeer	2019	Promulgated but regional not national value	2° Secondary
Netherlands	Gemeente Haarlemmermeer, Gemeente Amsterdam and Provincie Noord-Holland	PFOA	Groundwater	Not contaminated	0.00001	No	N/A	µg/L	Gemeente Haarlemmermeer	2019	Promulgated but regional not national value	2° Secondary
Netherlands	Gemeente Haarlemmermeer, Gemeente Amsterdam and Provincie Noord-Holland	PFOA	Groundwater	Contaminated - no remediation necessary	0.00039	No	N/A	µg/L	Gemeente Haarlemmermeer	2019	Promulgated but regional not national value	2° Secondary
Netherlands	Gemeente Haarlemmermeer, Gemeente Amsterdam and Provincie Noord-Holland	PFOA	Groundwater	Seriously contaminated - remediation necessary	>0.39	No	N/A	µg/L	Gemeente Haarlemmermeer	2019	Promulgated but regional not national value	2° Secondary
Netherlands	N/A	PFOA	Groundwater	Risk based value - humane risks, drinking water	0.0099	No	N/A	µg/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2021	Proposed	Tertiary
Netherlands	N/A	PFOA	Groundwater	Risk based value - ecological HC50	1000	No	N/A	µg/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2021	Proposed	Tertiary
Netherlands	N/A	PFOA	Groundwater	Risk based value - health risk MTR	2.7	No	N/A	µg/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2021	Proposed	Tertiary
Netherlands	N/A	PFOS	Groundwater	Risk based value - humane risks, drinking water	0.02	No	N/A	µg/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2021	Proposed	Tertiary
Netherlands	N/A	PFOS	Groundwater	Risk based value - ecological HC50	7000	No	N/A	µg/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2021	Proposed	Tertiary
Netherlands	N/A	PFOS	Groundwater	Risk based value - health risk MTR	8.6	No	N/A	µg/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2021	Proposed	Tertiary
Netherlands	N/A	GenX	Groundwater	Risk based value - humane risks, drinking water	0.33	No	N/A	µg/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2021	Proposed	Tertiary
Netherlands	N/A	GenX	Groundwater	Risk based value - ecological HC50	16000	No	N/A	µg/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2021	Proposed	Tertiary
Netherlands	N/A	GenX	Groundwater	Risk based value - health risk MTR	60	No	N/A	µg/L	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2021	Proposed	Tertiary
Switzerland	N/A	Mulitple PFAS	Groundwater	Groundwater Concentration Limit	0.05	Yes	Summation based on a Toxix Equivalent (TEQ) factor for the following 9 PFAS compounds: PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFBA, PFHxS and PFOS	µg TEQ/L	Eidegenossisches Departmenete fur Emwelt, Verkehr, Energie and Kommunikation UVEK	2022	Promulgated	Tertiary
European Union (EU)	EU Member States	24 PFAS Compounds	Groundwater	Proposed Environmental Quality Standard (EQS)	0.0044	Yes	Sum of 24 PFAS compound concentrations adjusted by a Relative Potency Factor (RPF)	µg/L	European Commission (EC)	2022	Proposed	Teriary
UK	N/A	PFOS	Groundwater	Concentrations in groundwater below which the danger of deterioration in the quality of the receiving groundwater is avoided	1	No	N/A	µg/L	UK Technical Advisory Group (UKTAG) on the Water Framework Directive	2016	Guidance value - predates most recent UK DWI thresholds related TDIs.	2° Secondary

Table 9 - PFAS Standards in Groundwater – North America

Country	State or Jurisdiction (if applicable)	Compound	Media [a]	Type	Value	Combined with other PFASs?	Additive PFASs	Units	Author	Current or Outdated?	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
USA	Colorado	8:2 FTS (as PFOA equivalent)	Groundwater	Narrative Policy Translation Levels	0.07	Yes	PFOA, PFOS, PFNA, NEtFOSAA, NMeFoSAA, PFOSA, 8:2 FTS	µg/L	Colorado Water Quality Control Commission	Current	01/07/2020	Promulgated	3° Tertiary
USA	New Jersey	ClPFPECAs	Groundwater	Interim Specific Ground Water Quality Criterion	0.002	No	n/a	µg/L	NJ Department of Environmental Protection	Current	1/18/2022	Promulgated	3° Tertiary
USA	Michigan	GenX	Groundwater	Groundwater for Drinking Water Criterion; Groundwater Cleanup Criteria	0.37	No	N/A	µg/L	Michigan Department of Environment, Great Lakes, and Energy	Current	21/12/2020	Promulgated	3° Tertiary
USA	Wisconsin	Multiple PFAS	Groundwater	Recommended Enforcement Standard	0.02	Yes	FOSA, NEtFOSA, NEtFOSE, NEtFOSAA, PFOS, PFOA	µg/L	Wisconsin Department of Health Services	Current	08/11/2020	Proposed	3° Tertiary
USA	Colorado	Multiple PFAS	Groundwater	Narrative Policy Translation Levels	0.07	Yes	PFOA, PFOS, PFNA, NEtFOSAA, NMeFoSAA, PFOSA, 8:2 FTS	µg/L	Colorado Water Quality Control Commission	Current	01/07/2020	Promulgated	3° Tertiary
USA	Minnesota	PFBA	Groundwater	Health Based Value (HBV - chronic and subchronic)	7	No	n/a	µg/L	Minnesota Department of Health (MDH)	Current	03/05/2018	Promulgated	3° Tertiary
USA	Michigan	PFBS	Groundwater	Groundwater for Drinking Water Criterion; Groundwater Cleanup Criteria	0.42	No	N/A	µg/L	Michigan Department of Environment, Great Lakes, and Energy	Current	21/12/2020	Promulgated	3° Tertiary
USA	Texas	PFDA	Groundwater	Residential PCL for groundwater ingestion	0.37	No	N/A	µg/L	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Texas	PFDoA	Groundwater	Residential PCL for groundwater ingestion	0.29	No	N/A	µg/L	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Texas	PFDS	Groundwater	Residential PCL for groundwater ingestion	0.29	No	N/A	µg/L	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Vermont	PFHpA	Groundwater	Preventive Action Level	0.002	Yes	PFOS, PFOA, PFNA, PFHxS, PFHpA	µg/L	Vermont Environmental Conservation Drinking Water and Groundwater Protection Division	Current	06/07/2019	Promulgated	3° Tertiary
USA	Hawaii	PFHpS	Groundwater	Environmental Action Level, < 150 m to surface water, groundwater IS NOT potential drinking water source	0.02	No	N/A	µg/L	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Texas	PFHxA	Groundwater	Residential PCL for groundwater ingestion	0.093	No	N/A	µg/L	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	New Hampshire	PFHxS	Groundwater	Ambient Groundwater Quality Standard	0.018	No	N/A	µg/L	New Hampshire Deparment of Environmental Services	Current	02/12/2021	Promulgated	3° Tertiary
USA	Michigan	PFNA	Groundwater	Groundwater for Drinking Water Criterion; Groundwater Cleanup Criteria	0.006	No	N/A	µg/L	Michigan Department of Environment, Great Lakes, and Energy	Current	21/12/2020	Promulgated	3° Tertiary
USA	Federal (U.S.) - EPA	PFOA	Groundwater	Preliminary Remediation Goal	0.07	Yes	PFOA, PFOS	µg/L	U.S. Environmental Protection Agency (EPA)	Current	19/12/2019	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFOA	Groundwater	Screening Level	0.04	No	N/A	µg/L	U.S. Environmental Protection Agency (EPA)	Current	19/12/2019	Proposed	2° Secondary
USA	Michigan	PFOA	Groundwater	Groundwater for Drinking Water Criterion; Groundwater Cleanup Criteria	0.008	No	N/A	µg/L	Michigan Department of Environment, Great Lakes, and Energy	Current	01/07/2020	Promulgated	3° Tertiary
USA	Wisconsin	PFOA	Groundwater	Recommended Enforcement Standard	0.02	Yes	PFOS, PFOA	µg/L	Wisconsin Department of Health Services	Outdated	22/02/2022	Proposed	3° Tertiary
USA	Wisconsin	PFODA	Groundwater	Recommended Preventive Action Limit	80	No	N/A	µg/L	Wisconsin Department of Health Services	Current	08/11/2020	Proposed	3° Tertiary
USA	Federal (U.S.) - EPA	PFOS	Groundwater	Preliminary Remediation Goal	0.07	Yes	PFOA, PFOS	µg/L	U.S. Environmental Protection Agency (EPA)	Current	19/12/2019	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFOS	Groundwater	Screening Level	0.04	No	N/A	µg/L	U.S. Environmental Protection Agency (EPA)	Current	19/12/2019	Proposed	2° Secondary
USA	Michigan	PFOS	Groundwater	Groundwater Surface Water Interface Criteria	0.012	No	N/A	µg/L	Michigan Department of Environmental Quality (DEQ)	Current	2018	Promulgated	3° Tertiary
USA	Texas	PFOSA	Groundwater	Residential PCL for inhalation of volatiles from groundwater, 30-acre source area	0.0068	No	N/A	µg/L	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Texas	PFPeA	Groundwater	Residential PCL for groundwater ingestion	0.093	No	N/A	µg/L	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Texas	PFTrDA	Groundwater	Residential PCL for groundwater ingestion	0.29	No	N/A	µg/L	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Texas	PFUA	Groundwater	Commercial/Industrial PCL for groundwater ingestion	0.88	No	N/A	µg/L	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary

Table 10 - PFAS Standards in Groundwater – Australia

Country	State or Jurisdiction (if applicable)	Compound	Media	Type	Value	Combined with other PFASs?	Additive PFASs	Units	Author	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
Australia	N/A	PFOS	Groundwater	Primary contact recreation	0.005	Yes	PFOS and PFHxS	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	N/A	PFHxS	Groundwater	Primary contact recreation	0.005	Yes	PFOS and PFHxS	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	N/A	PFOA	Groundwater	Primary contact recreation	0.05	No	N/A	µg/L	CRC Care	Mar-17	Proposed	3° Tertiary
Australia	New South Wales	Other	Groundwater	Trigger Point 1 Elevated contamination	0.01	Yes	all PFAS analytes measured	µg/L	EnRisks to New South Wales EPA	Feb-16	Proposed	3° Tertiary
Australia	New South Wales	Other	Groundwater	Trigger Point 2 Current Screening guideline	0.0001	Yes	all PFAS analytes measured	µg/L	EnRisks to New South Wales EPA	Feb-16	Proposed	3° Tertiary
Australia	New South Wales	Other	Groundwater	Trigger Point 3 Low level of contamination	0.00005	Yes	all PFAS analytes measured	µg/L	EnRisks to New South Wales EPA	Feb-16	Proposed	3° Tertiary

Table 11 - PFAS Standards in Soil – Europe and UK

Country	State or Jurisdiction (if applicable)	Compound	Media	Type	Value	Combined with other PFAS?	Additive PFASs	Units	Author	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
Denmark	N/A	Multiple PFAS	Soil	Health Based Value	0.0004	Yes	PFOS, PFOA, PFOSA, PFBS, PFBA, PFPeA, PFHxA, PFHpA, PFNA, PFDA, PFHxS, 6:2 FtS	mg/kg	Danish Ministry of the Environment	2015	Proposed	3° Tertiary
Germany	N/A	Multiple PFAS	Groundwater	Soil - Groundwater Pathway	Various	Yes	Soil leachate tests (2:1) compared to groundwater guideline values (2022)	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Guideline Values	3° Tertiary
Netherlands	N/A	GenX	Soil	Intervention value	0.057	No	N/A	mg/kg	Rijks Instituut voor Volksgezondheid en Milieu (RIVM)	2021	Proposed	3° Tertiary
Netherlands	N/A	PFOS	Soil	Soil reuse value - agriculture, nature, vegetable gardens	0.0014	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	PFOS	Soil	Soil reuse - urban areas	0.003	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	PFOS	Soil	Soil reuse - industry	0.003	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	PFOA	Soil	Soil reuse value - agriculture, nature, vegetable gardens	0.0019	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	PFOA	Soil	Soil reuse - urban areas	0.007	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	PFOA	Soil	Soil reuse - industry	0.007	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	Other PFAS	Soil	Soil reuse value - agriculture, nature, vegetable gardens	0.0014	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	Other PFAS	Soil	Soil reuse - urban areas	0.003	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	Other PFAS	Soil	Soil reuse - industry	0.003	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
UK	N/A	PFOA	Soil	Soil Screening Value (SSV) for waste recovery to land based on the secondary poisoning of birds and mammals	0.019	No	N/A	mg/kg	Environment Agency, WCA Environmental Ltd	2022	Promulgated	1° Primary
UK	N/A	PFOS	Soil	Soil Screening Value (SSV) for waste recovery to land based on the secondary poisoning of birds and mammals	0.013	No	N/A	mg/kg	Environment Agency, WCA Environmental Ltd	2022	Promulgated	1° Primary

Table 12 - PFAS Standards in Soil – North America

Country	State or Jurisdiction (if applicable)	Compound	Media [a]	Type	Value	Combined with other PFASs?	Additive PFASs	Units	Author	Current or Outdated?	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
USA	Federal (U.S.) - EPA	HFPO-DA	Soil	Risk- Based Screening Level (RSL), Residential	0.023	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	HFPO-DA	Soil	Risk-Based Screening Level (RSL), Composite Worker	0.35	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Texas	PFBA	Soil	Residential PCL for surface and subsurface soil to protect groundwater, 0.5-acre source area	0.2	No	N/A	mg/kg	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Federal (U.S.) - DoD	PFBS	Soil	Risk- Based Screening Level (RSL), Residential; for RI Determination	1.9	No	N/A	mg/kg	U.S. Department of Defense (DoD)	Current	2021	Promulgated	2° Secondary
USA	Federal (U.S.) - DoD	PFBS	Soil	Risk-Based Screening Level (RSL), Composite Worker; for RI Determination	25	No	N/A	mg/kg	U.S. Department of Defense (DoD)	Current	2019	Promulgated	2° Secondary
USA	Federal (U.S.) - DoD	PFBS	Soil	Risk- Based Screening Level (RSL), Residential; for RI Determination	19	No	N/A	mg/kg	U.S. Department of Defense (DoD)	Current	2021	Promulgated	2° Secondary
USA	Federal (U.S.) - DoD	PFBS	Soil	Risk-Based Screening Level (RSL), Composite Worker; for RI Determination	250	No	N/A	mg/kg	U.S. Department of Defense (DoD)	Current	2019	Promulgated	2° Secondary
USA	Federal (U.S.) - EPA	PFBS	Soil	Risk- Based Screening Level (RSL), Groundwater Protection	0.00019	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFBS	Soil	Risk- Based Screening Level (RSL), Residential	1.9	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	2021	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFBS	Soil	Risk-Based Screening Level (RSL), Composite Worker	25	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	2021	Proposed	2° Secondary
USA	Texas	PFBS	Soil	Residential PCL for surface and subsurface soil to protect groundwater, 0.5-acre source area	0.11	No	N/A	mg/kg	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Texas	PFDA	Soil	Residential PCL for surface and subsurface soil to protect groundwater, 30-acre source area	0.011	No	N/A	mg/kg	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Hawaii	PFDoDA	Soil	Environmental Action Level, > 150 m to surface water, groundwater IS potential drinking water source	0.0084	No	N/A	mg/kg	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Texas	PFDS	Soil	Residential PCL for surface and subsurface soil to protect groundwater, 30-acre source area	0.02	No	N/A	mg/kg	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Hawaii	PFHpA	Soil	Environmental Action Level, > 150 m to surface water, groundwater IS potential drinking water source	0.00029	No	N/A	mg/kg	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Hawaii	PFHpS	Soil	Environmental Action Level, > 150 m to surface water, groundwater IS potential drinking water source	0.0041	No	N/A	mg/kg	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary
USA	Texas	PFHxA	Soil	Residential PCL for surface and subsurface soil to protect groundwater, 30-acre source area	0.00024	No	N/A	mg/kg	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Federal (U.S.) - EPA	PFHxS	Soil	Risk- Based Screening Level (RSL), Groundwater Protection	0.000017	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFHxS	Soil	Risk- Based Screening Level (RSL), Residential	0.13	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFHxS	Soil	Risk-Based Screening Level (RSL), Composite Worker	1.6	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Massachusetts	PFHxS	Soil	S-1, S-2 and S-3 Soil and GW-1	0.0003	No	N/A	mg/kg	Massachusetts Department of Environmental Protection	Current	13/12/2019	Promulgated	3° Tertiary
USA	Federal (U.S.) - EPA	PFNA	Soil	Risk- Based Screening Level (RSL), Groundwater Protection	0.000025	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFNA	Soil	Risk- Based Screening Level (RSL), Residential	0.019	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFNA	Soil	Risk-Based Screening Level (RSL), Composite Worker	0.25	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Massachusetts	PFNA	Soil	S-1, S-2 and S-3 Soil and GW-1	0.00032	No	N/A	mg/kg	Massachusetts Department of Environmental Protection	Current	13/12/2019	Promulgated	3° Tertiary
USA	Federal (U.S.) - DoD	PFOA	Soil	Risk- Based Screening Level (RSL), Residential; for RI Determination	0.13	No	N/A	mg/kg	U.S. Department of Defense (DoD)	Current	2021	Promulgated	2° Secondary
USA	Federal (U.S.) - DoD	PFOA	Soil	Risk-Based Screening Level (RSL), Composite Worker; for RI Determination	1.6	No	N/A	mg/kg	U.S. Department of Defense (DoD)	Current	2019	Promulgated	2° Secondary
USA	Federal (U.S.) - DoD	PFOA	Soil	Risk- Based Screening Level (RSL), Residential; for RI Determination	1.3	No	N/A	mg/kg	U.S. Department of Defense (DoD)	Current	2021	Promulgated	2° Secondary
USA	Federal (U.S.) - DoD	PFOA	Soil	Risk-Based Screening Level (RSL), Composite Worker; for RI Determination	16	No	N/A	mg/kg	U.S. Department of Defense (DoD)	Current	2019	Promulgated	2° Secondary
USA	Federal (U.S.) - EPA	PFOA	Soil	Risk- Based Screening Level (RSL), Groundwater Protection	0.000091	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFOA	Soil	Risk- Based Screening Level (RSL), Residential	0.019	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFOA	Soil	Risk-Based Screening Level (RSL), Composite Worker	0.25	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Federal (U.S.) - DoD	PFOS	Soil	Risk-Based Screening Level (RSL), Composite Worker; for RI Determination	1.6	No	N/A	mg/kg	U.S. Department of Defense (DoD)	Current	2019	Promulgated	2° Secondary
USA	Federal (U.S.) - DoD	PFOS	Soil	Risk- Based Screening Level (RSL), Residential; for RI Determination	1.3	No	N/A	mg/kg	U.S. Department of Defense (DoD)	Current	2021	Promulgated	2° Secondary
USA	Federal (U.S.) - DoD	PFOS	Soil	Risk-Based Screening Level (RSL), Composite Worker; for RI Determination	16	No	N/A	mg/kg	U.S. Department of Defense (DoD)	Current	2019	Promulgated	2° Secondary
USA	Federal (U.S.) - EPA	PFOS	Soil	Risk- Based Screening Level (RSL), Groundwater Protection	0.0000038	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFOS	Soil	Risk- Based Screening Level (RSL), Residential	0.013	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Federal (U.S.) - EPA	PFOS	Soil	Risk-Based Screening Level (RSL), Composite Worker	0.16	No	N/A	mg/kg	U.S. Environmental Protection Agency (EPA)	Current	18/05/2022	Proposed	2° Secondary
USA	Michigan	PFOS	Soil	GSI protection (Great Lakes, connecting water, or near water intake)	0.00022	No	N/A	mg/kg	Michigan Department of Environmental Quality (DEQ)	Current	2018	Promulgated	3° Tertiary
USA	Texas	PFOSA	Soil	Residential PCL for surface and subsurface soil to protect groundwater for inhalation of volatiles pathway, 30-acre source area	0.011	No	N/A	mg/kg	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Texas	PFPeA	Soil	Residential PCL for surface and subsurface soil to protect groundwater, 30-acre source area	0.00016	No	N/A	mg/kg	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Texas	PFTeDA	Soil	Residential PCL for surface and subsurface soil to protect groundwater, 30-acre source area	0.056	No	N/A	mg/kg	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Texas	PFTrDA	Soil	Residential PCL for surface and subsurface soil to protect groundwater, 30-acre source area	0.03	No	N/A	mg/kg	Texas Commission on Environmental Quality	Current	06/01/2021	Promulgated	3° Tertiary
USA	Hawaii	PFUnDA	Soil	Environmental Action Level, > 150 m to surface water, groundwater IS potential drinking water source	0.0045	No	N/A	mg/kg	State of Hawaii, Department of Health	Current	08/04/2021	Proposed	3° Tertiary

Table 13 - PFAS Standards in Soil – Australia

Country	State or Jurisdiction (if applicable)	Compound	Media	Type	Value	Combined with other PFASs?	Additive PFASs	Units	Author	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
Australia	Federal (Airports)	6:2 FTS	Soil	Human Health Interim Screening Levels (HISLs) - industrial (direct contact only)	0.06	No	N/A	mg/kg	Department of Industrial and Regional Development and Airservices	Jun-15	Proposed	3° Tertiary
Australia	Federal (Airports)	8:2 FtS	Soil	Ecological Interim Screening Levels (EISLs) - terrestrial	0.00373	Yes	PFOA and 8:2 FtS	mg/kg	Department of Industrial and Regional Development and Airservices	Jun-15	Proposed	3° Tertiary
Australia	N/A	PFHxS	Soil	Human Health - Industrial / Commercial	20	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFHxS	Soil	Human Health - Public open space	1	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFHxS	Soil	Human Health - Residential with garden / accessible soil (based on 10% TDI)	0.01	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFHxS	Soil	Human Health - Residential with minimal opportunites for soil access	2	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOA	Soil	Human Health - Industrial / Commercial	50	No	N/A	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOA	Soil	Human Health - Public open space	10	No	N/A	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOA	Soil	Human Health - Residential with garden / accessible soil (based on 10% TDI)	0.1	No	N/A	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOA	Soil	Human Health - Residential with minimal opportunites for soil access	20	No	N/A	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOS	Soil	Human Health - Industrial / Commercial	20	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOS	Soil	Human Health - Public open space	1	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOS	Soil	Human Health - Residential with garden / accessible soil (based on 10% TDI)	0.01	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOS	Soil	Human Health - Residential with minimal opportunites for soil access	2	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary

Table 14 - Shortlisted PFAS Standards

Country	State or Jurisdiction (if applicable)	Compound	Media	Type	Value	Combined with other PFAS?	Additive PFASs	Units	Author	Date Issued or Updated	Proposed or Promulgated	Arcadis Suggested Ranking
UK and EU Countries	N/A	PFOS	Surface Water	AA-EQS Inland surface waters	0.00065	No	N/A	µg/L	EU Water Framework Directive (Directive 2013/39/EU) and UK Regulations 2017	2013	Promulgated	1° Primary
UK and EU Countries	N/A	PFOS	Surface Water	AA-EQS Other surface waters	0.00013	No	N/A	µg/L	EU Water Framework Directive (Directive 2013/39/EU) and UK Regulations 2017	2013	Promulgated	1° Primary
UK and EU Countries	N/A	PFOS	Surface Water	MAC-EQS Inland surface waters	36	No	N/A	µg/L	EU Water Framework Directive (Directive 2013/39/EU) and UK Regulations 2017	2013	Promulgated	1° Primary
UK and EU Countries	N/A	PFOS	Surface Water	MAC-EQS Other surface waters	7.2	No	N/A	µg/L	EU Water Framework Directive (Directive 2013/39/EU) and UK Regulations 2017	2013	Promulgated	1° Primary
UK	N/A	PFOS	Surface Water	Alterntive Empirical AA-EQS	0.003	No	N/A	µg/L	UK Environment Agency (EA)	2019	Empirically Derived Threshold	2° Secondary
European Union (EU)	EU Member States	24 PFAS Compounds	Surface Water	Proposed Environmental Quality Standard (EQS)	0.0044	Yes	Sum of 24 PFAS compound concentrations adjusted by a Relative Potency Factor (RPF)	µg/L	European Commission (EC)	2022	Proposed	3° Tertiary
UK	N/A	PFOA	Drinking Water	Tier 1 - Guidance Value (actions if below)	0.01	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	PFOA	Drinking Water	Tier 2 - Guidance Value (actions if below)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	PFOA	Drinking Water	Tier 3 - Guidance Value (actions if above)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	PFOS	Drinking Water	Tier 1 - Guidance Value (actions if below)	0.01	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	PFOS	Drinking Water	Tier 2 - Guidance Value (actions if below)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	PFOS	Drinking Water	Tier 3 - Guidance Value (actions if above)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	47 PFAS Compounds	Drinking Water	Tier 1 - Guidance Value (actions if below)	0.01	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	47 PFAS Compounds	Drinking Water	Tier 2 - Guidance Value (actions if below)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
UK	N/A	47 PFAS Compounds	Drinking Water	Tier 3 - Guidance Value (actions if above)	0.1	No	N/A	µg/L	UK Drinking Water Inspectorate (DWI)	2022	Promulgated	1° Primary
European Union Member States	N/A	Sum PFAS	Drinking Water	Drinking Water Limit Value	0.1	Yes	PFBA, PFPA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTrDA, PFBS, PFPS, PFHxS, PFHpS, PFOS, PFNS, PFDS, PFUnDS, PFDoDS, PFTrDS	µg/L	European Parliament and Council of the European Union	2021	Promulgated	1° Primary
European Union Member States	N/A	Total PFAS	Drinking Water	Drinking Water Limit Value	0.5	Yes	Total PFAS (e.g. by TOP Assay or TOF)	µg/L	European Parliament and Council of the European Union	2021	Promulgated	1° Primary
Germany	N/A	PFBA	Groundwater	Insignificance Threshold	10	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFPeA	Groundwater	Health Advisory Limit	3	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFHxA	Groundwater	Insignificance Threshold	6	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFHpA	Groundwater	Health Advisory Limit	0.3	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFOA	Groundwater	Insignificance Threshold	0.1	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFNA	Groundwater	Insignificance Threshold	0.06	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFDA	Groundwater	Health Advisory Limit	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFBS	Groundwater	Insignificance Threshold	6	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFHxS	Groundwater	Insignificance Threshold	0.1	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFHpS	Groundwater	Health Advisory Limit	0.3	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFOS	Groundwater	Insignificance Threshold	0.1	Yes	Quotient based summation with PFBA, PFHxA, PFOA, PFNA, PFBS, PFHxS and PFOS	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	6:2 FTS	Groundwater	Health Advisory Limit	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	PFOSA	Groundwater	Health Advisory Limit	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Germany	N/A	Other PFAS with R1-(CF2)n-R2, and n>3	Groundwater	Health Advisory Limit	0.1	No	N/A	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	2° Secondary
Switzerland	N/A	Mulitple PFAS	Groundwater	Groundwater Concentration Limit - protective of a drinking water resource	50	Yes	Summation based on a Toxix Equivalent (TEQ) factor for the following 9 PFAS compounds: PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFBA, PFHxS and PFOS	ng TEQ/L	Eidegenossisches Departmenete fur Emwelt, Verkehr, Energie and Kommunikation UVEK	2022	Promulgated	2° Secondary
UK	N/A	PFOS	Groundwater	Concentrations in groundwater below which the danger of deterioration in the quality of the receiving groundwater is avoided	1	No	N/A	µg/L	UK Technical Advisory Group (UKTAG) on the Water Framework Directive	2016	Guidance value - predates most recent UK DWI thresholds related TDIs.	2° Secondary
European Union (EU)	EU Member States	24 PFAS Compounds	Groundwater	Proposed Environmental Quality Standard (EQS)	0.0044	Yes	Sum of 24 PFAS compound concentrations adjusted by a Relative Potency Factor (RPF)	µg/L	European Commission (EC)	2022	Proposed	3° Tertiary
UK	N/A	PFOA	Soil	Soil Screening Value (SSV) for waste recovery to land based on the secondary poisoning of birds and mammals	0.019	No	N/A	mg/kg	Environment Agency, WCA Environmental Ltd	2022	Promulgated	1° Primary
UK	N/A	PFOS	Soil	Soil Screening Value (SSV) for waste recovery to land based on the secondary poisoning of birds and mammals	0.013	No	N/A	mg/kg	Environment Agency, WCA Environmental Ltd	2022	Promulgated	1° Primary
Netherlands	N/A	PFOS	Soil	Soil reuse value - agriculture, nature, vegetable gardens	0.0014	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	PFOS	Soil	Soil reuse - urban areas	0.003	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	PFOS	Soil	Soil reuse - industry	0.003	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	PFOA	Soil	Soil reuse value - agriculture, nature, vegetable gardens	0.0019	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	PFOA	Soil	Soil reuse - urban areas	0.007	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	PFOA	Soil	Soil reuse - industry	0.007	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	Other PFAS	Soil	Soil reuse value - agriculture, nature, vegetable gardens	0.0014	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	Other PFAS	Soil	Soil reuse - urban areas	0.003	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Netherlands	N/A	Other PFAS	Soil	Soil reuse - industry	0.003	No	N/A	mg/kg	Ministry of Infrastructure and Water	2021	Promulgated	2° Secondary
Australia	N/A	PFOS + PFHxS	Soil	Human Health - Industrial / Commercial	20	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOS + PFHxS	Soil	Human Health - Public open space	1	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOS + PFHxS	Soil	Human Health - Residential with garden / accessible soil (based on 10% TDI)	0.01	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOS + PFHxS	Soil	Human Health - Residential with minimal opportunites for soil access	2	Yes	PFOS and PFHxS	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOA	Soil	Human Health - Industrial / Commercial	50	No	N/A	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOA	Soil	Human Health - Public open space	10	No	N/A	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOA	Soil	Human Health - Residential with garden / accessible soil (based on 10% TDI)	0.1	No	N/A	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Australia	N/A	PFOA	Soil	Human Health - Residential with minimal opportunites for soil access	20	No	N/A	mg/kg	Heads of EPAs Australia and New Zealand (HEPA)	Jan-20	Promulgated	2° Secondary
Germany	N/A	Multiple PFAS	Groundwater	Soil - Groundwater Pathway	Various	Yes	Soil leachate tests (2:1) compared to groundwater guideline values (2022)	µg/L	Bundesministerium fur Umwelt, Naturschutz, Nukleare Sicherheit und Verbraucherschutz	2022	Promulgated	3° Tertiary

Table 15

		SampleCode	**Common Limpet St Ouen's Bay**	**Seaweed Fucus Serratus St Ouen's Bay**	**Seaweed Fucus Serratus St Ouen's Bay**	**Common Limpet St Aubin's Bay**	**Seaweed Fucus Serratus St Aubin's Bay**	**Seaweed Fucus Serratus St Aubin's Bay**	**Slipper Limpet St Aubin's Bay**	**Jersey Farmed Oysters Grouville Bay**	**Common Limpet Grouville Bay**	**Oysters Grouville Bay**	**Seaweed Fucus Serratus Grouville Bay**	**Seaweed Fucus Serratus Grouville Bay**	**Common Limpet West of Albert**	**Seaweed Fucus Serratus West of Albert**	**Seaweed Fucus Serratus West of Albert**
		Sampled_Date_Time	**27/09/2007**	**31/08/2011**	**27/09/2007**	**27/09/2007**	**31/08/2011**	**27/09/2007**	**19/10/2007**	**18/07/2007**	**27/09/2007**	**05/09/2009**	**30/08/2011**	**27/09/2007**	**27/09/2007**	**30/08/2011**	**27/09/2007**
		Lab_Report_Number	**EPR-R-2007-12-01**	**EPR-R-2012-02-21**	**EPR-R-2007-12-01**	**EPR-R-2007-12-01**	**EPR-R-2012-02-21**	**EPR-R-2007-12-01**	**EPR-R-2007-12-01**	**EPR-R-2007-12-01**	**EPR-R-2007-12-01**	**EPR-R-2009-10-13**	**EPR-R-2012-02-21**	**EPR-R-2007-12-01**	**EPR-R-2007-12-01**	**EPR-R-2012-02-21**	**EPR-R-2007-12-01**
		Lab_Name	M-Scan	M-Scan	M-Scan	M-Scan	M-Scan	M-Scan	M-Scan	M-Scan	M-Scan	M-Scan	M-Scan	M-Scan	M-Scan	M-Scan	M-Scan
ChemName	**output unit**	**EQL**															
Linear PFOS(Perfluoro-1-octanesulfonate)	µg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
6:2 Fluorotelomer Sulfonate (6:2 FtS)	µg/l		<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53
6:2 fluorotelomer sulfone amido sulfonate (6:2 FtSO2AoS)	µg/l		<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53
6:2 fluorotelomer sulfoxide amido sulfonate (6:2 FtSOAoS)	µg/l		<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53	<0.53
Perfluoro-1-butanesulfonate	µg/l		<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58
Perfluoro-1-hexanesulfonate	µg/l		<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Perfluorooctanoate (PFOA)	µg/l		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Perfluoro-1-heptanesulfonate	µg/l		<0.4	<0.58	<0.4	<0.4	<0.58	<0.4	<0.4	<0.4	<0.4	<0.4	<0.58	<0.4	<0.4	<0.58	<0.4
PFPeS	µg/l		<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58

ARCADIS

Appendix E

Conceptual Site Model and Preliminary Risk Assessment - Likelihood and Severity Ratings

Appendix E

Conceptual Site Model and Preliminary Risk Assessment

Likelihood and Severity Ratings

Classification of Severity

Severity classification relates to the impact on the route and development works. For example, the classification will be lower for sites that are off-site or more distant from the development boundary, or may be greater where planned development works are more likely to be impacted (e.g. site within areas of extensive earth works such as the north portal. Severity is also lower where a source is smaller in size or contaminants concentrations are likely to have depleted (e.g. due to age and degradability), or where identified receptors are of lower sensitivity.

Classification	Definition
Severe	Acute risk to human health, with the potential to result in significant harm. Significant pollution of controlled water. Catastrophic damage to a building/property constituting significant harm. An acute risk resulting in significant harm to an ecological system.
Medium	Chronic risk to human health with the potential to result in significant harm. Significant harm to controlled waters, such as the deterioration in water quality resulting in the lowering of classification of a water body. Significant harm, such as irreversible change, to an ecological system as defined in the Contaminated Land Statutory Guidance. Significant harm to a building/property resulting from long term effects such as sulphate attack.
Mild	Potential damage to crops, buildings, services and harm to the environmental and human health, which are unlikely to constitute significant harm but are viewed as constituting abnormal development costs. Potential for water quality standards to be exceeded in controlled waters which may constitute pollution, but unlikely to constitute significant pollution.
Minor	Harm, although unlikely to constitute significant harm, which may result in financial loss to the scheme, or expenditure to resolve. Potential risk to human health which may be readily managed by means including, but not limited to dust mitigation and personal protective clothing. Potential to locally affect water quality, but unlikely to cause water quality standards to be exceeded such that effects are permanent or alter the regional resource value of a receptor.

When applied to human health, controlled waters, ecological receptors or property such as buildings, the term ‘significant harm’ relates to the possibility of harm as defined in the Contaminated Land Statutory Guidance (Environment Agency, 2012).

Classification of Likelihood

Likelihood classification relates to the likelihood of a pollutant linkage being present. The likelihood is considered lowered if mitigating circumstances are likely to be present. For example, this may include the presence of underlying clay reducing the potential for lateral migration of groundwater, or overlying hardstanding reducing the potential for infiltration and human health exposure. Likelihood does not relate to the likelihood of pollution being present.

Classification	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.

Likely	There is a pollutant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period that such an event would take place, and is even less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

Matrix of Severity against likelihood to gain risk rating

		Severity			
		Severe	**Medium**	**Mild**	**Minor**
Likelihood	**High likelihood**	High	High	Medium	Low
	Likely	High	Medium	Low	Low
	Low likelihood	Medium	Low	Low	Low
	Unlikely	Low	Low	Low	Low

The risk ratings given have been consolidated from the CIRIA C552 risk classifications as follows:

- High: Analogous to Very High Risk or High Risk
- Medium: Analogous to Moderate Risk
- Low: Analogous to Moderate/Low Risk, Low Risk or Very Low Risk

As such, sites within the Low risk rating category still require investigation and further assessment.

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