ENVIROLOGIC

HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING

Hydrological Impact Assessment

Location:	Rathcoole, Co. Dublin
Prepared for:	Four Districts Woodland Habitat Group
Prepared by:	Colin O'Reilly PhD (Hydrology)
Date:	08/04/22
Reference no.	1972 v3

ENVIROLOGIC. LTD. ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13 · 01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE

Table of Contents

Non-Technical Summary

Envirologic were tasked by Four Districts Woodland Habitat Group with performing a hydrological assessment of Rathcoole Woodlands. The main objectives were to better understand the surface water (hydrological) and groundwater (hydrogeological) regimes of the woodland, and to establish how these influence ecological receptors such as trees and plants. The group also wanted to be informed on how any future development in the area will effect the woodland, and whether these effects are likely to be significant.

The woodland lies on reasonably flat ground at the bottom of a slope where elevations are around 120-130 mOD. From here land rises gradually south towards Lugg Hill (300 mOD), continuing to rise to Saggart Hill. Within the woodland itself ground slopes very gradually northwards, and continues to fall in that direction beyond the site to the River Liffey valley. Neither OS Discovery maps or on-site surveying, though limited, show the woodland to be within a valley.

The woodland has an area of just over 20 hectares (ha). There are no clear structures within the woodland, nor is there any clear evidence of historical activity such as agriculture. It lies just south of Rathcoole Village with the northern boundary coming up against the rear of a housing development (Coolamber). Lands to the south and southwest of the woodland are agricultural grasslands. East of the woodland land use changes to local amenity in the form of Rathcoole Park.

The woodland is covered with deep, well-drained soils while subsoils are a moderate permeability boulder clay (till) with estimated depths in the range 5-10 m. Bedrock underlying the woodland is made up of a greywacke/shale which comes up against limestone about 200 m to the north.

Bedrock beneath the site is considered to be a poor aquifer, meaning it is tight and transmits only low groundwater flow rates. Instead, a 1-3 m thick weathered zone at the bedrock/subsoil interface acts as the dominant subsurface flow path. Groundwater flow through this zone supports baseflow in rivers during summer months. Rainfall penetrating the bedrock aquifer is less than 100 mm/yr, with the remainder (300 mm/yr) travelling as shallow subsurface flow or surface overland flow. The low recharge acceptance of the bedrock aquifer can result in high groundwater levels.

The majority of the upland area to the south drains to the Camac River, which passes 40 m east of the woodlands, flowing north. The Camac River is flanked by alluvial deposits (river gravels) which infers that it was formed by natural glacial processes. Other streams and drains within and around the woodland are not mapped as being underlain by alluvium which would suggest that they were installed at some point for man-made drainage purposes.

Regarding the smaller streams desktop data across different sources (EPA, OPW, CFRAM) revealed inaccuracies and inconsistencies in terms of mapped channel routes, catchment areas and nomenclature. Watercourses were therefore groundtruthed during the site survey and mapped by Envirologic. The Fitzmaurice Stream flows in a northeast direction through the centre of the woodland. It runs perpendicular to the topographical slope yet does not correlate with a valley floor. The Rathcoole Stream flows adjacent to the southeast boundary of the woodland. The catchments to these two first order streams are similar, being relatively small. CFRAM mapping shows minimal fluvial flooding within the woodland. The SDCC SFRA maps are based on CFRAM mapping.

Streamflow direction through the woodland is southwest to northeast. Flow rates increase incrementally though the site confirming no major spring inflow or leaky river sections. pH values were generally neutral, becoming slightly more alkaline progressing through the site.

Groundwater levels were surveyed at a limited number of existing wells adjacent to the woodland and at one point within the woodland. The data was too limited to draw any firm conclusions but suggests groundwater flow direction is to the north, in line with topographical slope. Closer to open channels groundwater flow direction tends to be perpendicular to them.

Historical OSI maps show several springs in the area. These are probably linked to emergence of shallow groundwater when groundwater levels are high enough to intercept the ground surface. The ecology reports refer to several springs

within the woodland, the most significant of which is near the southwestern end, where tufa was observed. Historical maps show that the Rathcoole Stream was re-routed at this location within the past 100 years. The spring may therefore be linked to a preferential channel below surface that facilitates emergence of groundwater during winter periods. This spring is not active during spring and summer months. Inspection of other springs mentioned in one ecology report tended to correlate with ponded areas. It was difficult to ascertain whether this water was ponded rainfall or groundwater intercepting surface but it is notable that groundwater was measured in a nearby borehole at within 150 mm of surface.

The timing of the assessment did not allow for measurement of seasonal fluctuation in groundwater levels but there are clearly several indicators of groundwater being at or close to surface during winter months. As the upgradient groundwater is not captured by open field drains the groundwater flow path may be in the order of several hundred metres and potentially as far as a kilometre.

No groundwater or surface water samples were retrieved as part of the assessment. There are no significant point sources of contamination in the upgradient catchment and though there are agricultural grasslands they are not considered extensive enough in area to contribute significant nutrient loading to groundwater. As a result groundwater may be of high quality, though without supportive data it is acknowledged that this is somewhat speculative.

Along with the low south-north groundwater gradients the shallow groundwater present could support continuous groundwater flow close to surface beneath the woodland. This can provide a flushing effect in the uppermost 1.5 m of the soil/subsoil profile which is an important mechanism supporting alluvial woodlands. The ecological surveys confirmed a wet woodland that was supporting alluvial woodland habitat.

There is a high likelihood that any development works within, and in the immediate vicinity of, the woodland will disrupt the local hydrological and hydrogeological regime, thereby having a detrimental impact on the conditions currently supporting woodland habitat.

The woodland will be extremely sensitive to construction activities such as trafficking of heavy machinery, temporary drainage works, piling and construction dewatering. Though temporary in nature groundwater conditions do not always recover to the pre-works regime.

Permanent subsurface structures such as foundations can sever groundwater flow paths and cause groundwater mounding (increase in upgradient groundwater levels). The potential impacts from these should be assessed on a case-by-case basis.

Clearly, permanent drainage works are done with the intention of lowering groundwater levels in the long-term and this activity is perhaps the biggest threat to woodland conditions. The impact of drainage on the woodland will not only depend on proximity but position with respect to groundwater flow direction and orientation. Particular emphasis is placed in this regard on the upgradient area to the south where any drainage will intercept flows from the relatively long groundwater flow paths. Aside from removing groundwater that currently has a flushing effect, this intercepted groundwater would be transferred to surface waters which can have a knock-on effect of increasing flood risk to downstream receptors.

Introduction

The following hydrological impact assessment has been prepared by Colin O'Reilly PhD (Hydrology) of Envirologic Ltd. on behalf of Four Districts Woodland Habitat Group.

Colin O'Reilly of Envirologic accompanied Deirdre Tierney on a walkover of the woodland and vicinity on 9th April 2021 to inform the scope of works. The aims of the assessment were agreed as follows:

- Conceptualise the hydrological regime of the woodland;
- Assess the impact on the hydrological regime, if any, likely to occur as a result of additional development in the surrounding area. Outline the potential for impact to ecological receptors within the woodland where it is dependent upon hydrological regime.
- Inform future submissions from Four Districts Woodland Habitat Group related to zoning objectives and the updated South Dublin County Development Plan.

The following documents were reviewed as part of the desk study:

- South Dublin County Development Plan 2022-2028 Draft. South Dublin County Council.
- Chief Executives Report on submissions to the Draft Plan Public Consultation. 10th December 2021.
    - Appendix 1 Chief Executive Recommendations in Response to the OPR Submission;
    - Appendix 2A Rathcoole Lands Framework Concept and Zoning Proposals;
    - Appendix 2B Rathcoole Lands Ecology Report. 31st November 2021;
    - Appendix 7 SEA, AA and SFRA Assessment of CE Amendments;
    - Proposed Amendments following Chief Executive Recommendations on Submissions to the Draft.
- A survey to assess the woodlands and associated semi-natural habitats at Rathcoole, Co. Dublin. Prepared by Dr Rory Hodd, Nimbus Ecology, August 2021.
- Recent planning applications in the area.

Follow-up field survey works were performed by Envirologic at Rathcoole Woodlands on 20th-21st January 2022.

Site Description

Site Location

Rathcoole Woodland ('the site') is located 300 m south of Rathcoole village. The M7 motorway, which runs in a southwest-northeast direction passes 350 m to the north. The site is within County Dublin, with the Dublin-Kildare border coming to within 3.1 km of the southeastern boundary of the woodland. The southern extents of the woodland define the boundary between Rathcoole townland, within which the site is located, and Coolmine townland to the immediate south.

The site lies at the base of a hill which falls from the northwestern corner of the Dublin Mountains (Figure 1). This portion of the Dublin Mountains is characterised by a pair of north-trending ridges which lie approximately 2 km apart, these being:

- Saggart Hill (395 mOD), 3 km to the south of the site, which falls to a secondary peak Knockandinny (346 mOD), 2.4 km to the south;
- Knockannavea (396 mOD), 4 km to the southeast of the site, which falls to a secondary peak Verschoyles Hill (332 mOD), 2.4 km to the southeast.

The intervening north-trending valley is interrupted by Lugg Hill (309 mOD) which peaks 1.6 km to the south of the site and pushes the deeper part of the valley around the eastern side of the hill. This valley forms the headwaters of the Camac River. Lands slope northwards from Lugg Hill, steeply at first, with gradient shallowing out below 200 mOD and north of a local road which connects Saggart village with Redgap. Some very minor valleys are present on this north-facing slope.

1:50,000 OS Discovery maps show that Rathcoole Woodland is itself relatively flat, with a slight gradient from the southwestern corner (130 mOD) to the northeastern boundary (120 mOD), and a lesser slope from south to north. Beyond the site lands continue to fall northwards towards Baldonnell Aerodrome.

Site Layout

The study area occupied an area of approximately 215,850 m^2 (c. 21.6 ha), defined as the red line boundary in Figure 2. Figure 2 shows that the area is irregular in shape but can be broadly described as a rectangle orientated southwest to northeast with a length of 720 m parallel to the M7 and a perpendicular width which narrows from 400 m at the southwestern end to 140 m at the northeastern end. The southwestern, southeastern and northeastern edges are reasonably straight with the northwestern boundary being more irregular.

Land Use

Historical OSI 25" mapping shows that Rathcoole Woodlands contained several individual land parcels.

In some parts of the woodland floor low ridges are evident. Historical mapping does not indicate any overground structures within the woodland area. Google imagery suggests that the woodland area has not had any management or land use intervention for at least 15 years, and likely significantly longer.

The lands to the south and southwest and sloping towards the woodlands are used for agriculture and are currently in grassland production. Historical OS mapping (25" and 6") suggests no other type of land use has taken place on these parcels for a significant period of time. The local road south of these grassland fields and 500 m to the southeast of the woodland is flanked by ribbon development of one-off housing. A small number of these houses have agricultural farmyards attached.

The area between the northern site boundary and Main Street in Rathcoole village contains residential housing (Coolamber), established circa 1970. It is mostly the rear boundaries of these dwellings which back onto Rathcoole Woodlands with these boundaries being defined by a raised block wall. 130 m from the northwestern corner the boundary of the woodlands step inwards for a distance of 35 m and subsequently 105 m, giving way to maintained grassland. Progressing eastwards

the area between the woodlands and Coolamber residential estate becomes part of Rathcoole Park. This contains walkways and maintained grasslands, with playing pitches further to the east. There has been no significant change in land use since pre-2009.

A triangular arrangement of houses known as Rathcoole Park adjoins the northwestern site corner. These houses have been in situ since pre-2008. Aerial photography suggests that the larger estate to the west (Peyton) commenced construction in 2009.

Soils & Geology

Soils

Soils at the site are mapped by the Geological Survey of Ireland (GSI) and Teagasc as being deep and well-drained with an acidic signature (Figure 3). Gardiner and Radford (1980) mapping shows these soils to be primarily grey brown podzolics, a mainly dry mineral soil.

There is no Teagasc soil book covering County Dublin. The Teagasc publication Soils of County Kildare does not extend to Rathcoole.

Subsoils

The quaternary period encompasses the last 1.6 million years and deals with the subsoils and sediments that were deposited over the bedrock described below. The Pleistocene (1.6 million years – 10.000 years ago) is commonly known as the last Ice Age, which was a period of intense glaciation separated by warmer inter-glacial periods, and it is during this period that the quaternary sediments seen today were deposited. Large amounts of ponded water were present at this stage resulting in considerable fluvioglacial sedimentation.

Quaternary deposits at the site are mapped by the GSI as moderate permeability till derived from Lower Palaeozoic sandstones and shales (Figure 4), presumably derived from upland bedrock outcrop to the south. The shale till gives way to limestone tills on the lower, flatter lands north of the site. The calcareous parent material has been carried in from the Irish Sea and intermixed with the local limestone and shale.

The Camac River to the east is mapped as being underlain by alluvial deposits which infers that it was naturally formed. Further to this the Camac is flanked by limestone gravels to a maximum width of 170 m. The smaller tributaries and channels in close proximity to, and running through the site, are not shown to be running through alluvial deposits.

Bedrock

Bedrock and structural geology in the vicinity of the site is illustrated in Figure 5, with reference to the 1:100,000 bedrock geology Sheet 16: Geology of Kildare-Wicklow (GSI, 1994). The site lies on a significant east-west structural fault which extends for 40 km between Dublin Bay at Blackrock to Staplestown. The fault separates Dinantian Upper Impure Limestones to the north, which form the central basin of Ireland, and Silurian Metasediments and Volcanics which form the Wicklow and Dublin Mountains. This fault is mapped as corresponding with the northern boundary of Rathcoole Woodlands.

At a more local scale, geology is further influenced by a perpendicular fault extending southwards from Rathcoole Village towards Saggart Hill. This fault corresponds with the western boundary of Rathcoole Woodlands and defines the western edge of the Poulaphouca Formation which underlies the majority of the site. The Poulaphouca Formation is described as a coarse greywacke and shale. The various other bedrock formations in close proximity to the site are a varying composition of shales, greywackes and slate. These are shown to dip southeast at 50°, outcropping at the base of the primary formations exposed on the Wicklow Mountains.

Geotechnical

Previous geotechnical site investigation works to inform development of the Liffey Aqueduct (Site Investigations, 1981) returned the following results in close proximity to the site:

- 150 m west of southwestern corner - depth to bedrock > 4.5 m;
- 400 m south of southeastern corner - depth to bedrock > 4.5 m;
- 250 m southeast of southeastern corner - depth to bedrock > 4.0 m;
- Adjacent to southeastern corner - depth to bedrock > 4.0 m.
- 100 m north of northeastern corner - depth to bedrock > 3.1 m
- 350 m north of northeastern corner - depth to bedrock > 1.2 m;
- 300 m north of northeastern corner - depth to bedrock < 2.0 m.

Although there is no accessible record of site investigation works having been conducted before within Rathcoole Woodlands it would appear from the above data that depth to bedrock is generally greater than 5 m.

A report entitled 'Site Investigation for Saggart to Leixlip Trunk Watermain' (Site Investigations, 1985) summarised lithology encountered during shell and auger drilling and rotary-percussion drilling in the area. The nearest shallow borehole was BH3, positioned 100 m east of the eastern boundary of the woodlands. Subsoils here were consistent with that across much of the studied area, being a slightly stony, brown, silty clay (boulder clay).

Hydrogeology

Aquifer Classification

Figure 6 presents aquifer classification in the area. The Poulaphouca shales underlying Rathcoole Woodlands are classified as a poor aquifer, being generally unproductive with the exception of local zones (Pl) while bedrock belonging to the Carrighill Formation (greywacke, siltstone, shale) to the west is classified as being generally unproductive (Pu). These types of aquifer generally have few and poorly connected fractures, fissures and joints. This low fissure permeability tends to decrease further with depth hence the majority of groundwater flow will occur in the top couple of metres along a weathered zone. Permeability in these Lower Palaeozoic rocks can also be influenced by folding and faulting and resultant fracturing. In general, the poor fissure network results in poor aquifer storage, short flow paths (tens of metres) and low 'recharge acceptance'. Groundwater discharge to streams ('baseflow') is very limited. Groundwater flow direction is in a lateral direction towards rivers and springs, in this formation mainly from the raised uplands to the south towards the low-lying ground at Rathcoole woodlands.

Figure 6 shows that the impure limestones to the north, belonging to the Lucan Formation, are classified by the GSI as a locally important aquifer which is moderately productive only in local zones (Ll). Deeper fracture flow, up to a depth of 30 m, is more likely to be active in this aquifer class.

There are no gravel aquifers in the vicinity of the woodlands.

The aquifer classifications infer that the greywackes and shales underlying the site would be regarded as having a lower primary porosity and permeability than the limestones to the immediate north.

The site is within the Kilcullen Groundwater Body (GSI, 2004). This is a large GWB and the summary report contains no information at site-scale relevant to the site. The report states that regional flow paths are not expected to develop as the

rocks do not have sufficient transmissivity to transport water over long distances. Typical groundwater flow paths will tend to be less than a couple of hundred metres, with discharge occurring to the closest surface water features.

The GSI well database does not contain any records in the area.

Springs

Springs marked on historical OSI 6" and 25" maps have been superimposed onto aerial imagery in Figure 7.

The map shows that springs tend to be most likely to occur at the break in gradient or toeslope. The Kilcullen GWB report (GSI, 2004) confirms that there are a large number of small springs present in the area. The positions of these springs most likely correspond to a significant change in slope gradient or a change in bedrock formation. There are insufficient number of points to confirm either.

Groundwater Vulnerability

Groundwater vulnerability is a measure of the risk that a potential groundwater contamination event may have on the groundwater beneath. It is a measure of how vulnerable groundwater is to a potential contamination event. The vulnerability of groundwater is a function of the nature of the underlying soil cover, the presence and nature of the subsoil, the nature of strata, and the thickness of overburden above the water table.

The vulnerability categories, and methods for determination, are presented in Groundwater Protection Schemes (1999). The guidelines state that 'as all groundwater is hydrologically connected to the land surface, it is the effectiveness of this connection that determines the relative vulnerability to contamination. Groundwater that readily and quickly receives water (and contaminants) from the land surface is considered to be more vulnerable than groundwater that receives water (and contaminants) more slowly and in lower quantities. The travel time, attenuation capacity and quantity of contaminants are a function of the following natural geological and hydrogeological attributes of any area:

1. the subsoils that overlie the groundwater;
2. the type of recharge - whether point or diffuse;
3. the thickness of the unsaturated zone through which the contaminant moves.

Table 1 - Vulnerability Mapping Criteria (DELF/EPA/GSI, 1999)

Subsoil Thickness	Hydrogeological Requirements				
	Diffuse Recharge			Point Recharge	Unsaturated Zone
	Subsoil Permeability & Type			(Swallow holes, losing streams)	(Sand & gravel aquifers only)
Subsoil thickness	High permeability (sand & gravel)	Moderate permeability (sandy subsoil)	Low permeability (clayey subsoil, clay, peat)		
0 - 3 m	Extreme	Extreme	Extreme	Extreme (30 m radius)	Extreme
3 - 5 m	High	High	High	n/a	High
5 - 10 m	High	High	Moderate	n/a	High
> 10m	High	Moderate	Low	n/a	High
Note: (i) n/a = not applicable (ii) Permeability classifications relate to the material characteristics as described by the subsoil description and classification method.					

Groundwater below or within the low permeability sandstone/shale till subsoils in the area are shown to become less vulnerable as elevations fall (Figure 8). This is due to thickening subsoils as gradient changes from the upper hillsides into the flatter valley. The vulnerability map and classification criteria infer that subsoil depth increases from 5 m on the toeslope, to over 10 m on the flatter ground within the woodland.

Rainfall & Recharge

Rainfall

Monthly gridded rainfall data as sourced from Met Éireann (Walsh, 2012) is presented in Table 2.

Table 2 - Long term mean monthly rainfall data (mm) (Met Éireann)

J	F	M	A	M	J	J	A	S	O	N	D	Total
77	59	61	63	67	68	62	80	72	95	87	90	882

Effective rainfall (ER) is determined by deducting annual evapotranspiration (AE) from average annual rainfall (AAR). Actual evapotranspiration (AE) is estimated by multiplying Potential Evapotranspiration (PE) by 0.95, to allow for the reduction in evapotranspiration during periods when a soil moisture deficit is present (Water Framework Directive, 2004).

The GSI database states that effective rainfall (ER) applicable to the area is 399 mm/yr.

Recharge

Recharge refers to the rainfall that enters the aquifer. Based on the hydrogeological setting mapped by the GSI of moderate permeability subsoil overlain by well-drained soil and high groundwater vulnerability, the recharge coefficient is 60 %.

Using the effective rainfall calculated from GSI, this yields an annual recharge rate to top of bedrock of 239 mm yr^{-1}.

Due to the nature of the bedrock aquifer underlying the site (Pl), the GSI impose a cap of 100 mm upon the amount of recharge that can penetrate through bedrock head. Recharge rejected at top of competent bedrock (299 mm yr^{-1}) travels downgradient as groundwater flow in the weathered transition zone or as surface overland flow.

Hydrology

Watercourses & Catchments

The primary watercourse in the area is the Camac River. Making reference to the EPA river network database and OPW CFRAM documents applicable to Hydrometric Area 9 it was noted that there are differences in nomenclature for watercourses in the area. First and second order streams which flow around or through Rathcoole Woodlands are listed in Table 4. In attempt to avoid confusion and to provide consistency throughout the report the OPW nomenclature will be applied. Reference was also made to historical OSI 6" and 25" maps (see Plate 1). The historical map for the relevant area does not transpose into the mapping software at a satisfactory resolution and the reader is referred to the data source at www.geohive.ie. The local surface water network as confirmed by groundtruthing is illustrated in Figure 9.

Figure 10 shows the estimated catchments of the streams which were presented in Figure 9 and described in Table 4. The catchments of the Rathcoole Stream and Fitzmaurice Stream are similar in scale at 0.8 km^2 and 1.2 km^2, respectively.

Designated Areas

The site is not within or directly adjoining any part of a designated area. Slade of Saggart and Crooksling Glen pNHA is located 1,500 m upstream of the site. This is the valley through which a section of the Camac flows. This designated site is upgradient of the application site and is not influence by hydrology in or around Rathcoole Woodlands.

Table 4 - Watercourses relevant to Rathcoole Woodland

OPW Reference	EPA Reference	Catchment to Downstream Site Boundary, km²	Description
Camac River	Camac River	10.0 km²	Rises at Brittas Lake, an elevated waterbody between Saggart Hill and Knockannavea before travelling northwards alongside the N81 and through the narrow valley between these two peaks, around the eastern flank of Lugg Hill. The Camac turns northwest upon meeting the Old Slade Road (L6042) and is then culverted beneath Castle Road via a stone arch bridge. Approximately midway between Castle Road and the M7 the Camac comes to within 40 m of the eastern boundary of Rathcoole Woodlands. The Camac continues to flow parallel to Rathcoole Park and Casement Aerodrome. It ultimately outfalls to the tidal section of the River Liffey at Heuston Station.
Rathcoole Stream	Crookshane Stream	0.8 km²	The Rathcoole Stream flows along eastern half of the southern boundary of Rathcoole Woodlands, coinciding with the downgradient boundary of the agricultural plots to the south. Historical mapping suggest that this watercourse was fed by a spring that rose just south of the southwestern corner of the woodlands. The spring was likely fed by disconnected streams to the south flowing through preferential subsurface channels. Current mapping and aerial photography show that this stream is now fed by the Coolmine Stream. The Rathcoole Stream outfalls to the Camac River close to the southeastern corner of the woodlands.
Coolmine Stream	Slade Stream	Included in Rathcoole Stream	An open, unmaintained channel that rises near Coolmine Equestrian Centre, 600 m southwest. Enters the Rathcoole Stream roughly midway along the southern boundary of the woodlands.
Fitzmaurice Stream	Coolmine Stream	1.2 km²	Rises at the southwestern corner of Rathcoole Woodlands before being directed northeastwards through the centre of the woodland. Flow contributing to this stream appears to be sourced within the woodlands themselves though this requires groundtruthing. Flows northwards through a series of ponds in Rathcoole Park, with water levels in each cascading lake controlled by a series of broadcrested weirs. Flows eastwards upon reaching the M7 and appears to outfall to the Camac immediately upstream of where it is culverted beneath the M7.
Link	Coolmine Stream	Negligible	Mapping shows a channel division in Rathcoole Park which diverts some of Fitzmaurice Stream water eastwards into an open channel. Flows through the central axis of Rathcoole Park before outfalling to the Camac to the rear of Springbank residential estate.
Western Boundary		Unconfirmed, < 0.2 km²	A stream which flows in a northerly direction along the western boundary of the woodland is not shown on OPW or EPA sources. It can be observed as a pair of parallel channels in Plate 1. For simplicity it is referred to in this report as the Western Boundary Stream.

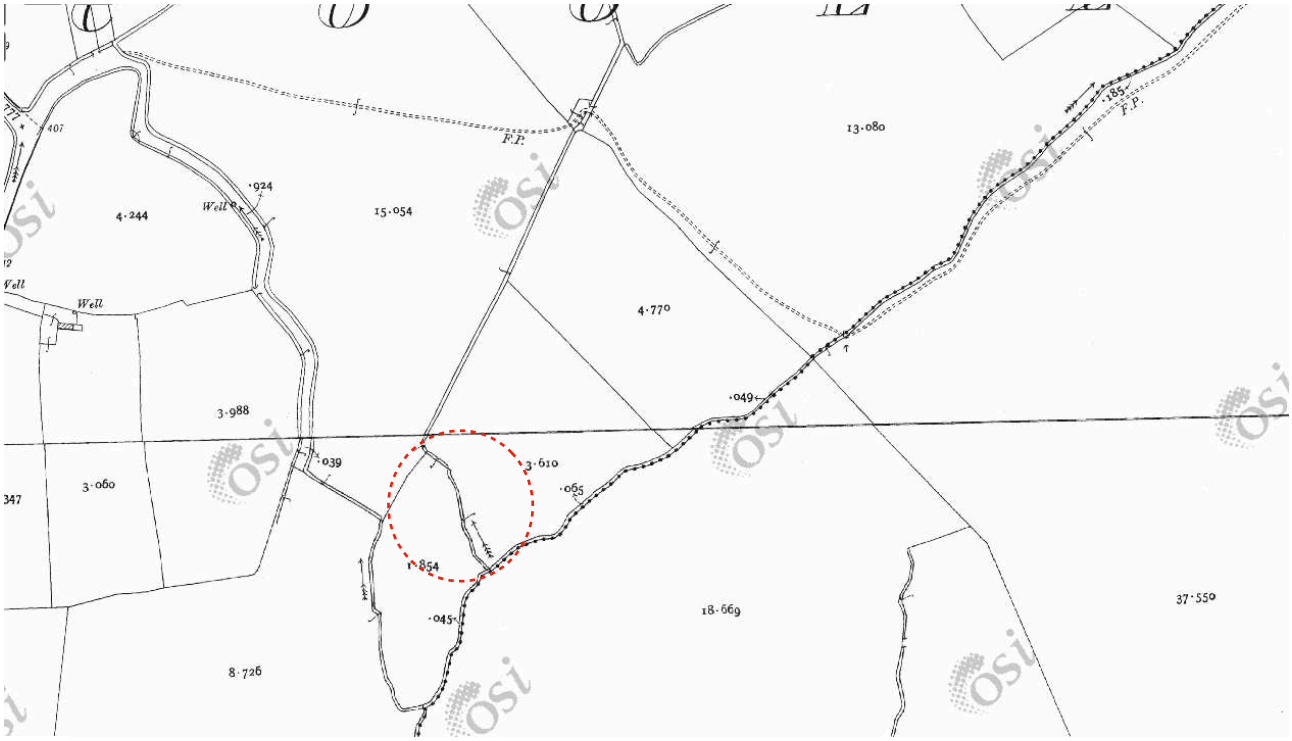
Flooding History

Historical OSI Maps

Neither the historical 6" OSI maps, dated c.1837-1842, or the slightly more detailed 25" OSI maps (c.1888-1913) show any indicators of flooding on site or in the immediate vicinity.

Plate 1 below presents part of the OSI 25" map for the area and demonstrates that watercourses have been historically altered when this map is compared to current groundtruthed channels. Most notable is the connecting channel highlighted in Plate 1 that transfers waters from what is now a dry ditch along the southern boundary (upstream of Rathcoole Stream) to the Fitzmaurice Stream. Evidence of historical concrete structures were observed in the vicinity of the inlet and outlet of this short channel, these possibly being previous headwall structures.

Plate 1 - Historical OSI 25" map for area (note arrows indicate streams)



Historical Events

The HA09 Inception Report (OPW, 2012) states that the River Camac overflowed in 1993 resulting in flooding to roads and houses in Rathcoole and Saggart.

Consultation of the OPW flood hazard mapping tool shows that the nearest mapped historical flood event on the Camac River was 200 m downstream of its confluence with the Coolmine/Link Stream at Avoca roundabout. A flood event was recorded at this location in 2011 and local authority notes attributed this to a blocked culvert. Mitigation measures have since been implemented at this location.

Benefitting Land Maps

OPW maps show that the site is not classified as being within benefiting lands. Such lands are considered to have benefitted from arterial drainage schemes. None of the watercourses in and around Rathcoole are maintained as part an OPW arterial drainage network.

Hydrometric Gauges

There are no active hydrometric gauges in the vicinity of the site. The nearest gauge on the Camac is Killeen Road, 9 km downstream of the woodlands.

Flood Defence Works

To counteract known flood risk areas in the local authority jurisdiction river/stream improvements works were carried out over the past twenty years. These included the Camac River Phase I Improvement Scheme (1995) and the Camac River Phase II

Improvement Scheme (2001). Such works were not carried out in the vicinity of the site which would infer it was not a priority flood risk area.

Anecdotal Evidence

Committee members belonging to the Four Districts Woodland Habitat Group have described flooding in the area on 24th October 2011 following heavy rainfall. This included flooding of 2 houses at the end of Coolamber Road and another on Mulally's Road in October 2011. The source of flooding was attributed to a large volume of water in the stream that flows north along the western boundary of the woodlands resulting in the downstream culvert become surcharged. Debris at the culvert inlet may have exacerbated the problem.

Flood Prediction Maps

pFRA Maps

The preliminary Flood Risk Assessment (pFRA) map tile for the area is not available. The Rathcoole, Saggart and Baldonnell area was selected as an AFA (Area for Further Assessment).

FRR Maps

Following publication of pFRA maps the OPW issued Flood Risk Review Maps in 2011. The map for the Rathcoole area shows that the southern third of the woodland is at risk of potential flooding, seeming to spread northwards from the Rathcoole stream. The Rathcoole stream is also shown to be at risk of potential flooding between the midpoint along the southern boundary and the Rathcoole outfall to the Camac.

CFRAM

The Eastern CFRAM programme involved detailed 1D-2D hydraulic modelling and produced fluvial flood risk maps for the area, with a primary focus on the Camac River (see Figure 11). CFRAM nodes relevant to the woodlands and the corresponding predicted flood flows and accompanying levels in the Camac River and its tributaries in the area provided in Table 5.

The CFRAM modelling shows negligible fluvial flooding within the woodland. Contributing catchments to each node could not be sourced which in light of findings to date may mean the values in Table 5 should be treated with caution. At the majority of nodes listed in Table 5 flow rates are not available.

Previously described low terracing that runs close, and parallel, to watercourses can be formed due to long-term erosion processes and their presence can often correlate with recurring flood extents. However, there is no evidence that the local streams are flashy in terms of hydrology and this explanation for ground undulations is ruled out.

Pluvial flooding occurs when heavy rainfall that exceeds ground infiltration capacity or more commonly in Ireland where the ground is already saturated from previous rainfall events. This causes ponding and flooding at localised depressions.

Table 5 - CFRAM flood flows and levels around Rathcoole Woodlands

Node	Watercourse	Node Location	10% AEP flow, $m^3 s^{-1}$	1% AEP flow, $m^3 s^{-1}$	0.1% AEP flow, $m^3 s^{-1}$	10% AEP level, mOD	1% AEP level, mOD	0.1% AEP level, mOD
09RATH00106	Fitzmaurice	220 m upstream of SW corner	n/a	n/a	n/a	140.1	140.24	140.33
09RATH00082	Fitzmaurice	SW corner	1.11	2.06	3.56	132.50	132.66	132.78
09RATH00036	Rathcoole	Midway along southern boundary	n/a	n/a	n/a	125.65	125.86	126.09
09RATH00002!	Rathcoole	SE corner	1.36	2.61	4.15	118.15	118.29	118.39
09FITZ00136	Fitzmaurice	80 m downstream (N) of SW corner	0.04	0.08	0.14	129.60	129.64	129.71
09FITZ0086	Fitzmaurice	Midway along northern boundary	n/a	n/a	n/a	121.86	121.89	121.97
09FITZ000371	Fitzmaurice	400 m downstream (N) of northern boundary	n/a	n/a	n/a	111.22	111.29	109.61
09FITZ00078I	Fitzmaurice	Northern boundary	n/a	n/a	n/a	121.45	121.62	121.82
09LINK00034		240m east of northern boundary	n/a	n/a	n/a	114.95	114.97	115.12
09CAMM01639W	Camac	200 m upstream (S) of RATH outfall	3.32	6.41	11.61	122.57	122.59	122.60
09CAMM01571	Camac	160m downstream of LINK outfall	n/a	n/a	n/a	108.57	109.05	109.61

SDCC Development Plan SFRA 2022-2028

Roughan O'Donovan published a Strategic Flood Risk Assessment in 2021 for inclusion in the South Dublin County Development Plan (SDCDP) 2022 - 2028. The indicative flood risk areas are shown in Plate 2 below and correspond with those presented on CFRAM maps.

Plate 2 - Indicative flood risk areas and riparian corridors (pink) for Rathcoole-Saggart Area (SDCC, 2021)

The SFRA map for the Rathcoole area has been included as Appendix A. It shows potential flood flow pathway upstream of the southwestern corner of the woodland. These lands were not accessible as part of the field survey and so could not be validated. A flood pathway is also again shown between the Rathcoole Stream (dry ditch section) and the Fitzmaurice Stream within the southwestern corner of the woodland. It is assumed this connection was derived from a topographical

depression revealed from LIDAR data. Additional flooding was highlighted adjacent to the Rathcoole Stream, close to its outfall. A raised embankment is positioned corresponding to this flow pathway but it was not active during site walkover survey.

Site Investigation

The desk study revealed a lack of consistency in terms of mapped channel routings, catchment areas and nomenclature. Field survey works were carried out on 20th-21st January 2022. The surveyed area was restricted to public lands in and around Rathcoole Woodlands. Works undertaken included the following:

- Groundtruthing of watercourses to clarify accuracy of available data sources.
- Topographical survey, using Trimble RTK VRS, accurate to < 0.025 m.
- Surface water elevations surveyed using Trimble RTK VRS to confirm surface water flow directions.
- Flow gauge selected watercourses in and around Rathcoole Woodlands using AquaData Fluvia RC3 to validate approximate areas of delineated catchments and to check for any losing stream sections.
- Measure unstable field hydrochemistry (pH, temperature, conductivity, DO) in selected watercourses using InSitu AquaTroll Multiparameter sonde. This was carried out for initial screening of water quality, verifying whether 'springs' are groundwater or surface water fed and if there is a groundwater influence, whether this is from acidic or alkaline bedrock.
- Identify any groundwater wells in and around Rathcoole Woodlands and where accessible measure groundwater level using a dipmeter. Survey in borehole(s) using RTK VRS for reduced groundwater elevation. This was carried out to confirm groundwater head levels in the area.
- Identify any unique hydrogeological features in the area such as springs. Survey water elevation and measure spring discharge rate.

Topography

The feasibility of a detailed topographical survey using RTK VRS technique was curtailed by canopy cover. A more detailed TSS survey was not within the scope of the study. An attempt was made to survey a cross section through the centre of the woodland, along a northwest-southeast axis. Although brief it showed that ground levels continue to decrease northwest from the Fitzmaurice Stream towards Rathcoole village. This would suggest that where it flows through the woodland the Fitzmaurice Stream may not occupy a natural linear valley.

Surface Water Elevations

Surface water elevations were surveyed at 25 locations (see Figure 12). These confirm all mapped watercourses flow generally in a northerly direction.

Flow Gauging

Manual flow gauging was carried out on the 21st January 2022 at several locations, marked in Figure 13. Flows in the Rathcoole Stream and Fitzmaurice Stream where they cross the upgradient site boundary are similar, which would suggest that they have similar sized catchments.

Flows in the Fitzmaurice Stream increase incrementally from 11 l/s at the upstream site boundary to 17 l/s where it exits Rathcoole Park. The Fitzmaurice Stream does not appear to be significantly gaining or losing which would suggest there are no major springs present, and no leaky structures in the stream channel.

No water was observed in 'Link' Stream, between the western entrance to Rathcoole Park and the Camac River.

No flows were observed in the open drains that flow perpendicular towards the Fitzmaurice Stream, outfalling to it broadly in the centre of the woodland site.

Field Hydrochemistry

There is no significant variation in pH, conductivity or dissolved oxygen across the monitored locations. Slightly lower temperatures and conductivities were recorded in the Rathcoole Stream when compared to that of the Fitzmaurice Stream which may indicate slightly less contact time with subsoils and bedrock. This would be expected due to the steep topographical gradients and low permeability subsoil and bedrock on lands to the south, resulting in surface overland flow being the dominant flow path.

Residence time of rainfall-runoff-recharge may be prolonged by the flatter gradients surrounding the Fitzmaurice Stream. In the Fitzmaurice Stream temperature at the outlet was slightly lower than at the other upstream locations. This is likely due to the water storage influence of the lakes, which exposed water to the lower background air temperatures for longer (air temperature on day of site survey was 4°C).

pH values were recorded across a very narrow range, however some trends could be detected. The lowest pH values (6.9 - 7.1) were detected in the Rathcoole Stream and the upper reaches of the Fitzmaurice Stream. These neutral values suggest surface overland flow is the dominant pathway and that there is minimal influence from Carboniferous limestone. Progressing northwards pH values increase marginally towards 7.3. This slightly alkaline signature may be indicative of groundwaters and surface waters coming into contact with limestone, or more simply presence of limestone.

Groundwater Levels

Groundwater levels were measured at 5 monitoring boreholes in a plot adjoining the northwestern boundary of the woodlands (Figure 12). On the northern side of the stream groundwater flow direction is implied as being generally to the north, in line with ground levels as described above. A higher number and distribution of groundwater monitoring points would be necessary to confirm this.

Groundwater was measured at depths of 1 - 1.6 m below surface in an area immediately north of the woodland. The plot containing these 5 boreholes was flanked on two sides by open drainage channels which may have caused some artificial lowering of groundwater. Groundwater levels at points setback 10 m from the Fitzmaurice Stream were 1.3 m below surface, equal to 200 mm above adjoining surface water levels. Hence within close proximity to open channels the surface watercourses act as baseflow sinks and groundwater flows towards them.

Groundwater level was also measured in a test hole within the woodland itself, at a depth of only 0.15 m below surface. The 125 mm open hole is possibly a legacy from previous site investigations by third parties, to which Envirologic have not found any reference. Groundwater elevation at this location was 0.15 m below surface (equivalent to 129.6 mOD), this level being below the upgradient dry ditch which was formerly active. This would infer that groundwater flow in the area south of the woodland, between the Fitzmaurice Stream and the Coolmine Stream, outfalls directly to the Fitzmaurice Stream in the centre of the woodland, i.e. it is not captured in any intermediate drainage ditches.

There are no lithology logs for these boreholes in the public domain.

Springs

A small complex of about six small groundwater discharges (Plate 4) were observed between the Fitzmaurice Stream and the Rathcoole Stream, in the same area as an open channel was mapped in historical OSI 25" maps (refer to Plate 3).

Conductivity levels in the waters emerging from Spring SPR 6 (590 µS cm^{-1}) were notably higher when compared to that of receiving surface waters (440 µS cm^{-1}). This was attributed to prolonged contact time with subsoils or weathered bedrock.

Temperature in waters emerging from Spring SPR 6 (7.2 °C) are equivalent to that recorded in nearby upstream and downstream surface waters (7.3 - 7.6 °C). Groundwater within the bedrock aquifer would be expected to have temperatures in the order of 10 °C. It is therefore deduced that the discharges are not emanating from the bedrock aquifer but rather rising due to a historical watercourse which was most likely piped and has now become blocked, or through the superficial deposits.

Plate 4 - Cluster of groundwater discharges at SPR6

In addition committee members of the Four Districts Woodland Habitat Group provided a small number of data points of potential interest. These are shown in Figure 14 and are briefly described as:

- Location 1 = small, channelised overland flow, similar in nature to SPR6 as shown in Plate 3 above;
- Location 2 = ponding in channel at northwest site corner. This is possibly due to an impedance or undersized culvert (300 mm PVC) which transmits the western boundary stream;
- Location 3 = ponded area adjacent to the open channel junction in the centre of the site. This may be attributed to a localised enclosed topographical depression with poor infiltration characteristics.

Unfortunately it was not within the scope of the study to revisit these locations and assess flow and hydrochemistry.

Preliminary Conceptual Site Model

Using the desktop information collected to date, along with field results, a preliminary conceptual site model (CSM) of Rathcoole Woodlands hydrology is outlined below. It is important to note that our understanding at this point is limited by the lack of site-specific data, particularly lithological profiles, permeability of various strata and water quality data.

- Rathcoole Woodlands is positioned on relatively flat, low-lying lands at the foot of one of the northern slopes of the Dublin Mountains. The woodlands do not occupy a valley floor, rather there is a slight northerly topographical gradient through the site.
- GSI maps show soils to be deep and well-drained with an acidic signature. GSI mapping does not show any alluvial deposits; these are often an indicator that watercourses have been naturally formed and/or have been prone to flooding.
- GSI maps show subsoils to be low permeability till derived from the sandstones and shale material washed down from uplands to the south during glacial erosion. North of the woodland quaternary deposits change to carboniferous-dominated substrate.
- Bedrock in the area consists of impure limestones and shale/sandstone. Neither of these formations are prone to karstification and their catchments do not normally contain springs, swallow holes, dolines, etc.
- Bedrock is of low permeability, with most subsurface flow being in the weathered zone at the bedrock/subsoil interface.
- The dominant recharge process in the area will be diffuse recharge from rainfall percolating through the overlying tills and into the aquifer. High rates of potential recharge are expected in areas where subsoils are thin or even absent, such as upper hillslopes. However a large portion of this potential recharge will be rejected at bedrock head because the rocks in this area are considered to be poor aquifers. Therefore the proportion of runoff and shallow subsurface groundwater flows generated from precipitation is expected to be relatively high. This appears to be reinforced by the high natural drainage density within the area.
- Springs are shown on historical maps and noted by local residents. Given the local geology it is likely that these waters represent infiltrating rainfall that has been rejected at bedrock head or due to low permeability subsoil strata, moving via preferential subsurface flow paths before emerging at surface. The point nature of these emergent waters can also be attributed to artificial subsurface drainage channels or infilled watercourse reaches which have subsequently become blocked. Given the thick depth of subsoils in the woodland it is unlikely that the observed 'springs' are due to interaction with bedrock.
- Historical OSI 25" mapping for the area shows that the most productive spring within the woodland coincides with the approximate routing of a historic open drainage channel that formed the headwaters of the Fitzmaurice Stream. pH value at the cluster of springs at SPR6 was 6.9.
- Historical OSI 25" mapping shows that drainage channels in the area have been re-routed over time.
- The woodland is bisected by the Fitzmaurice Stream which runs perpendicular to the topographical slope. This stream does not occupy the valley floor.
- The Rathcoole Stream runs adjacent to the upgradient (southern) boundary of the woodland. In places the woodland floor is lower than the invert (base) of the Rathcoole Stream which has resulted in a dry ditch upgradient of SPR6.
- Groundwater levels adjacent to the woodland in areas close to drainage channels were 1 - 1.6 m below ground. In contrast, groundwater levels within the woodland were measured at 0.15 m below surface. Additional lithology and topographical data would be required to draw an accurate hydrogeological cross section through the site.
- In general the woodland floor was noted as being wet. In isolated areas ponding occurs, likely reflective of localised, enclosed topographical depressions. These observations suggest the subsoil is saturated for parts of the year, due either to high groundwater level or low infiltration capacity, or a combination of both.

Ecology

One of the aims of the assessment was to attempt to explain how hydrological and hydrogeological controls ecology at the site. To facilitate this Envirologic have made reference to two recent ecological reports:

- *A survey to assess the woodlands and associated semi-natural habitats at Rathcoole, Co. Dublin*. Prepared by Dr Rory Hodd, Nimbus Ecology, August 2021. Commissioned by Four Districts Woodland Habitat Group.
- *Rathcoole land ecology assessment*. Prepared by Faith Wilson and Joanne Denyer, November 2021. Commissioned by Brady Shipman Martin on behalf of South Dublin County Council.

The following documents are not in the public domain and were unavailable for review as part of this assessment:

- Lands at Rathcoole - Preliminary Ecological Appraisal Report (Brady Shipman Martin, 2020);
- Lands at Rathcoole - Screening for Appropriate Assessment (Brady Shipman Martin, 2019);
- Lands at Rathcoole - Urban Design Framework (Brady Shipman Martin, 2019);
- Tree Review for the Rathcoole Urban Design Framework (Brady Shipman Martin, 2019).

The findings of the Preliminary Ecological Appraisal Report (PEAR) (2020) are considered superseded by the more detailed survey findings of Wilson and Denyer (2020).

Wilson & Denyer (2021)

Faith Wilson and Dr Joanne Denyer were commissioned by Brady Shipman Martin to carry out an ecological assessment of Rathcoole Woodlands to supplement a preliminary ecological appraisal and to inform a masterplan for the lands at Rathcoole by South Dublin County Council. The report is included as Appendix 2B of the Chief Executives Report on submissions to the Draft Plan Public Consultation. The two surveyors are botanists with expertise in wetland habitats, springs and grasslands.

Wilson and Denyer (2021) state that Rathcoole Woodlands consist of 8 ha of wet woodland, wet and dry grassland, scrub, mature hedgerows, streams, ditches and small access paths. The more detailed habitat classifications and corresponding areas are listed in Table 6. The resulting habitat map is shown in Figure 15.

Table 6 - Habitat types and corresponding areas within Rathcoole Woodlands

Habitat Code	Habitat	Area, ha	Length, m
WL1	Hedgerows		2,942
FW4	Drainage ditches		773
FW1	Streams		1,296
FP1	Calcareous springs (point)	0.03*	
FP1	Calcareous springs (line)		76
FS1	Reed and large sedge swamps	0.1	
GS2	Dry meadows and grassy verges	5.04	
GS2 - WS1 mosaic	Mosaic dry meadow and grassy verges and scrub	6.78	
GS4	Wet grassland	0.58	
WN6	Wet-willow-alder-ash woodland	8.0	
WS2	Immature woodland	2.4	

* the size of the area covered by the springs varies seasonally and is likely to be greater in winter

Key findings of the Faith and Wilson (2021) report are summarised below:

- The area mapped as WN6 wet willow-alder-ash woodland (see Figure 15) passes the criteria for Annex I priority habitat: Alluvial Woodland [91E0]. This is regarded as being of County to National-scale ecological importance and the Irish State is obliged to protect it.
- The report makes reference to a NPWS (2019) document giving the citation: '*..all types (of alluvial woodland) occur on heavy soils which are periodically inundated by the annual rise of river levels, but which are otherwise well-drained and aerated during low water'.*
- SPR6 is a petrifying spring displaying tufa (calcium carbonate precipitate). Wilson & Denyer did not observe flow emanating from SPR6 on two of the three visits. The groundwater discharge is therefore temporal in nature and likely active in wetter winter and spring months. Due to this temporal flow regime the spring does not qualify as an Annex I priority habitat: Petrifying Spring [7220].
- A second spring was observed in the northeastern part of the site. Envirologic observed flow at this location in the scoping visit (9th April 2021) but not during January 2022. The discharge here has possibly been disrupted by earth-moving works. This spring was reported as being of local-scale ecological importance.
- Annex 1 Habitat: Lowland Hay Meadows [6510] was recorded in the northern portion of the site, directly adjoining Rathcoole Park. This is regarded as being of County-scale ecological importance.
- The wetland species at the site infer groundwater table remains high all year round at this site and that the site is prone to local winter flooding.
- The site is important from the perspective of both flora and fauna.

Hodd (2021)

Dr Rory Hodd of Nimbus Ecology was commissioned by Four Districts Woodland Habitat Group to investigate and assess the habitats present in and around Rathcoole Woodlands. In the main Hodd (2021) reiterated the findings of Wilson and Denyer (2021). Within a prescribed study area of 24 ha Hodd (2021) determined that 12.8 ha of the site can be classified as alluvial woodland. Points of interest from the Hodd (2021) report are listed as follows:

- Wet woodland is reliant upon a high water table.
- The woodland habitat provides shade and humidity, essential to support a rich species diversity on the woodland floor.
- The woodland plays an important role in hydrological regulation and a reduction in flooding in the Camac catchment.
- This site should be designated as a proposed Natural Heritage Area (pNHA).
- The site in its entirety should not be zoned for development due to its high biodiversity and ecosystems services value.
- A protective buffer zone around the site should be maintained and any future developments should take into account any potential impacts on this site.
- It should be ensured that adjacent activities and development do not alter the water table, which could have a knock-on effect on the composition and quality of the wet woodland habitat.

Revised Conceptual Site Model

Indicator species and other findings of the ecological field surveys allow for the preliminary CSM to be revised. The CSM is refined as follows:

- Within Rathcoole Woodlands is a large area of nationally important habitat that is wholly dependent upon local hydrology and hydrogeology.
- Species type and diversity in Rathcoole Woodlands is controlled by the combination of:
  - low topographical gradients,
  - a thick layer of moderate permeability subsoils with unconfirmed infiltration characteristics,
  - a low permeability bedrock aquifer,
- These factors give rise to the following supporting conditions:
  - a high proportion of rainfall is rejected at surface resulting in intermittent ponding (pluvial flooding),
  - rainfall which does penetrate the surface will likely flow laterally in the uppermost 0.15 m to 1.5 m,
  - there is likely to be some groundwater flow in the weathered bedrock zone (interface of bedrock and subsoils). This is likely to be recharged on the upper slopes. This flow path likely sustains baseflow in rivers during summer months.
  - the poor bedrock aquifer means a high proportion of recharge is rejected at bedrock head. The rejected groundwater can accumulate beneath the surface can result in groundwater being close to surface.
- There is no significant variation of habitat type and vegetation based on distance from open watercourses.

Potential Impacts

It is not deemed necessary to carry out a review of all historical planning applications in the area at this time. Rather all future proposals should be assessed on a case-by-case basis and take into account any proposed mitigation measures. As the study has revealed that the woodland ecology is controlled by local hydrology and hydrogeology it follows that any alterations to same are likely to have a detrimental impact to the woodland.

Though by no means exhaustive the woodland is likely to be extremely sensitive to some or all of the following activities, with reference to specific areas where works have potential to have a higher degree of impact:

- Simple site investigation works can have a negative impact, e.g. (i) trafficking of heavy machinery can cause degradation of soil and subsoil infiltration characteristics; (ii) trial pit excavations
- Woodland hydrology is likely to be severely impacted by any development works on lands to the southeast. Any drainage or excavations in this area will capture shallow groundwater that currently flows through the southern half of the woodland before reaching the Fitzmaurice Stream. This shallow groundwater does not appear to be captured currently by the drainage channel upstream of the woodland, instead flowing beneath the base of the drain.
- Drainage is installed to lower groundwater levels. Any drainage works along the northern boundary will act as a baseflow sink and intercept shallow groundwater currently flowing in a northwards direction. The distance from a drain to which groundwater levels are lowered is related to subsoil permeability.
- Available groundwater levels have shown that the overall groundwater flow direction is reversed in areas close to open channels.

- Although unconfirmed depth to bedrock may be as much as 10 m. In order to reach stable foundation-supporting strata any development may require sheet piled walls. These are a major impediment to groundwater flow and would have a significant impact on hydrogeology across the entire site. In the case that subsoils are sufficiently stiff raft foundations may be utilised. These structures will have the same negative impact as sheet piles in that they can block out all shallow groundwater pathways.

- Excavations are required to facilitate installation of foundations. Excavation depth is linked to desired building use (e.g. underground car parking). Excavations alter local groundwater gradients and act as sumps.

- Installation of foundation requires dry working conditions. Given the high groundwater levels it is almost certain that significant pumping would be required to maintain dry working conditions, with the duration linked to construction phase. Prolonged pumping has potential to induce significant lowering of groundwater levels across an extensive area.

- All of the above are typically listed as short-term impacts which respond to pre-construction levels upon completion. Whilst this is often the case there have been instances where construction works have altered groundwater flow paths that cannot be reinstated post-works. An example of this is Thormanby Woods in Howth where site clearance works, significant excavation and drainage installation exposed and captured significant shallow subsurface flow paths. These flows then emerged as springs on exposed faces and captured in linear drains before being diverted to stormwater infrastructure. The hydrological regime supporting a downgradient woodland in the form of diffuse shallow groundwater flows was severely disrupted as a result. Attempts at reinstatement of hydrological controls were unsuccessful and the woodland suffered irreparable damage as a result.

Draft South Dublin County Development Plan 2022-2028

The findings of this assessment may have a bearing on future planning decisions within or adjoining Rathcoole Woodlands. The assessment is not intended to sterilise lands in the area that may be used to provide new houses or local educational, medical or recreational facilities. It is however intended that the consideration is given to the local hydrogeological regime, and the potential impacts that may occur to same, if development proceeds in an inappropriate manner. In some cases there may be suitable mitigation strategies.

SDCC Development Plan SFRA 2022-2028

It is worth noting that the SFRA places a new emphasis on riparian corridors and the importance of the vegetative diversity that develops in these areas. The following key points relating to riparian corridors are listed below as follows:

- Riparian corridors protect watercourses and their natural processes including: ecological, biogeochemical, hydromorphological and flood resilience in the face of climate change.

- The sustainable management of riparian zones is crucial to meeting our objectives under the Water Framework and Floods Directives.

- Removal of upland and riparian vegetation through agriculture and urbanisation disrupts land-water linkages leading to reductions in water quality, simplification of stream channels, less stable thermal and flow regimes, and ultimately, reduced ecosystem integrity.

- Riparian vegetation is a key source of beneficial in-stream nutrients and carbon, provides shade aiding thermally sensitive species (e.g. salmonids) and directly influences channel morphology (bank stabilisation, source of Large Woody Debris).

- Where proposed development lands are within the Riparian Corridor but are not directly adjacent to a watercourse, measures should focus on SuDS to manage the quality and quantity of surface water runoff and promote biodiversity.

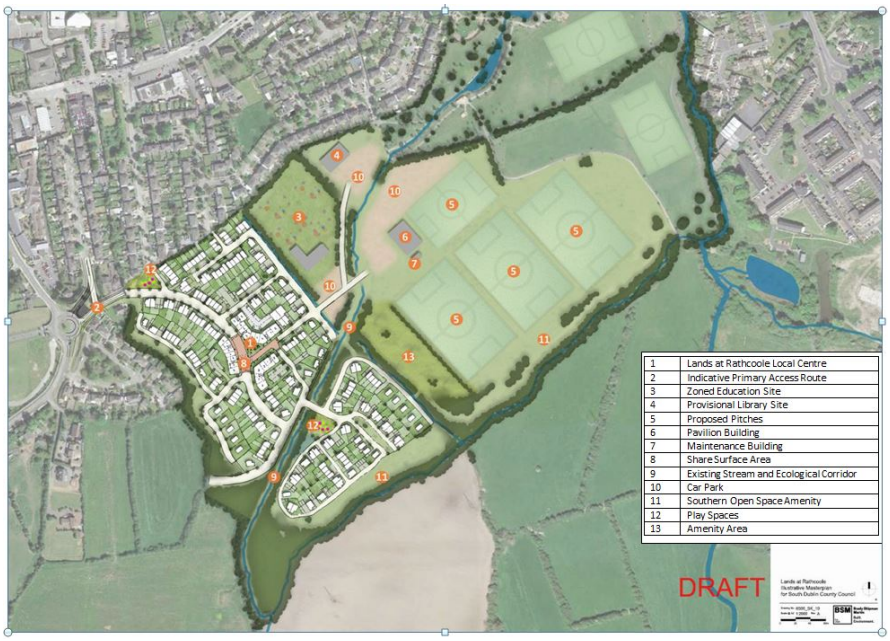
- In general restorative measures should create “Room for the River” and in time allow river systems to return to a state of equilibrium with rich biodiversity, developed ecosystem service provision and resilience to future shocks such as climate change. Potential restorative measures are described below.
- The immediate riparian buffer should be “re-wilded” as much as possible.
- Inclusion of riparian trees is important as currently the majority of catchments in the Dublin region have very little tree cover.
- To promote and protect native riparian vegetation along all watercourses and ensure that a minimum 10m vegetated riparian buffer from the top of the riverbank is maintained/reinstated along all watercourses within any development site.

Rathcoole Woodlands satisfy all of the above conditions listed above. Any future development area must ensure that the above criteria are not comprised in and around Rathcoole Woodland.

Land Use Zoning

A Masterplan was drafted in recent years for Rathcoole Woodlands and surrounding areas in July 2019 (see Plate 5).

Plate 5 - Draft Rathcoole Masterplan (SDCC, 2020)



Land use zonings proposed by SDCC in the vicinity of Rathcoole Woodlands have been superimposed on aerial imagery in Figure 15. In this plan the woodlands have been bisected in terms of proposed future land use along a northwest-southeast central axis as follows:

- lands to the northeast of the central axis given as: OS = to preserve and provide for open space and recreational amenities;
- lands to the southwest of the central axis given as: Res-N = to provide for new residential communities in accordance with approved area plans. This area has been subject to recent planning application (known locally as the ‘Romville Development’.

Agricultural lands to the south of the woodlands are mapped as RU: to protect and improve rural amenity and to provide for the development of agriculture. Existing residential estates in the surrounding area are mapped as RES: to protect and/or improve residential amenity.

More recently the land use zoning has been modified by inclusion of a 'Specific Local Objective Boundary' which broadly corresponds with the boundary for Rathcoole Woodlands as shown in the Envirologic Figures appended to this report. Specific Local Objective CS10 SLO:1 states:

- *To investigate the potential for alternative land uses for the lands currently zoned RES-N (To provide for new residential communities in accordance with approved area plans) and OS (To preserve and provide for open space and recreational amenities) as identified by the SLO on the CDP land use zoning map, having regard to protecting existing habitats, biodiversity and the Rathcoole Woodlands, the need for social and affordable housing, community infrastructure and access. Following this assessment, and where alternative land use arrangements are identified in line with the proper planning and sustainable development of the area, to bring forward proposals for re-zoning.*

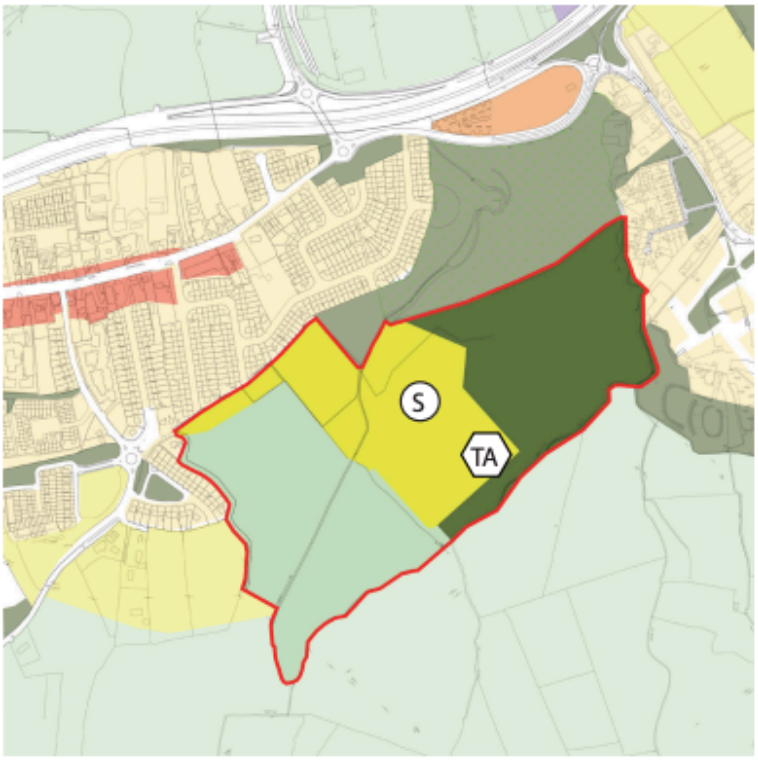
Furthermore, additional local objectives have been defined as follows:

- Specific Local Objective GI7 SLO:1 = *the current green wildlife corridor between Saggart and Rathcoole be maintained and the need to preserve this wildlife corridor be incorporated into the design and development plans for Rathcoole park.*
- Specific Local Objective GI7 Objective 3 = *to work in collaboration with the owners of lands along the perimeter of Rathcoole Woodlands for its protection and that of the wildlife using it and the ecological services it provides.*
- NCBH 8 Objective 6 (also GI 7 Objective 3) = *to work in collaboration with the owners of lands along the perimeter of Rathcoole Woodlands for its protection and that of the wildlife using it and the ecological services it provides.*

Figure 15 also illustrates the routing of a proposed road which will run parallel to the southern boundary of the woodlands, setback to a distance of 90-140 m. It is envisaged that this is part of a long-term plan for the region (> 6 years).

More recently, an emerging concept zoning map was put forward in a report issued by Metropolitan Workshop in 2021 entitled '*SDCC Rathcoole Lands: Land Use Concept and Zoning Proposals*'. This scheme is shown below in Plate 6. The preferred concept places additional emphasis on the woodlands and the habitats and biodiversity supported by same. It achieves this by preserving the 2.5 ha southwestern portion of the woodlands and altering (in part relocating and reducing) the zoning allocated to RES-N. The preferred scheme states that there will be zero loss of Annex I habitat when alluvial, immature and hay meadow are considered as a whole.

Plate 6 - Emerging Concept Zoning Map (Metropolitan Workshop, 2021)



Note: Extent of proposed RES-N zone includes school site and dedicated public open space that will serve residential development as per the Preferred Land Use Concept and Landscape Strategy

Emerging Concept Zoning Map

	Change from Current
RES-N 8.6 Ha	-2.5 Ha
RU 10.3 Ha	+8.5 Ha
OS 9.3 Ha	-5.9 Ha

References

DoEHLG, 2009. *The Planning System and Flood Risk Management.* Department of Environment, Heritage and Local Government, Dublin.

Gardiner, M.J., Radford, T, 1980. *Soil associations of Ireland and their land use potential.* National Soil Survey of Ireland.

GSI, 2004. Kilcullen GWB description. Geological Survey of Ireland.

McConnell, B., Philcox, M.E. 1994. *Sheet 16: Geology of Kildare-Wicklow.* 1: 100,000 Bedrock Geology Map Series, Geological Survey of Ireland.

Metropolitan Workshop, 2021. *SDCC Rathcoole Lands: Land Use Concept and Zoning Proposals.* Commissioned by Aecom on behalf of South Dublin County Council.

Nimbus Ecology (Hodd, R.), 2021. *A survey to assess the woodlands and associated semi-natural habitats at Rathcoole, Co. Dublin*. Commissioned by Four Districts Woodland Habitat Group.

NPWS (2019). The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments. Unpublished NPWS report. Edited by: Deirdre Lynn and Fionnuala O'Neill.

OPW, 2012. *Eastern CFRAM Study - HA09 Inception Report*.

OPW, 2016. *Eastern CFRAM Study - HA09 Hydraulics Report: Camac Model*.

South Dublin County Council, 2021. *Draft South Dublin County Development Plan 2022 - 2028*. SDCC

Wilson, F. and Denyer, J. 2021. *Rathcoole land ecology assessment*. Commissioned by Brady Shipman Martin on behalf of South Dublin County Council.

Appendix A SDCC Development Plan SFRA Map

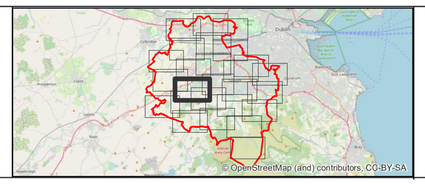
N

Legend

- Watercourses
- Flood Zone A – 1%AEP Flood Extent (1 in 100 Year Flood)
- Flood Zone B – 0.1%AEP Flood Extent (1 in 1000 Year Flood)
- Riparian Corridor
- County Boundary

0 100 200 400 600 800 1,000 m

Comhairle Contae Átha Cliath Theas
South Dublin County Council



No.	Revision	Date	By	Chk'd	App'd

ROD
ROUGHAN & O'DONOVAN
Consulting Engineers
Civil - Structural - Transportation - Environmental
Arena House,
Arena Road,
Sandyford,
Dublin 18,
Ireland
t +353 (0) 1 294 0800
www.rod.ie

Drawn	Designed	Checked	Approved	Suitability Code - Description
LA	WV	WV	JPR	S2 - Information

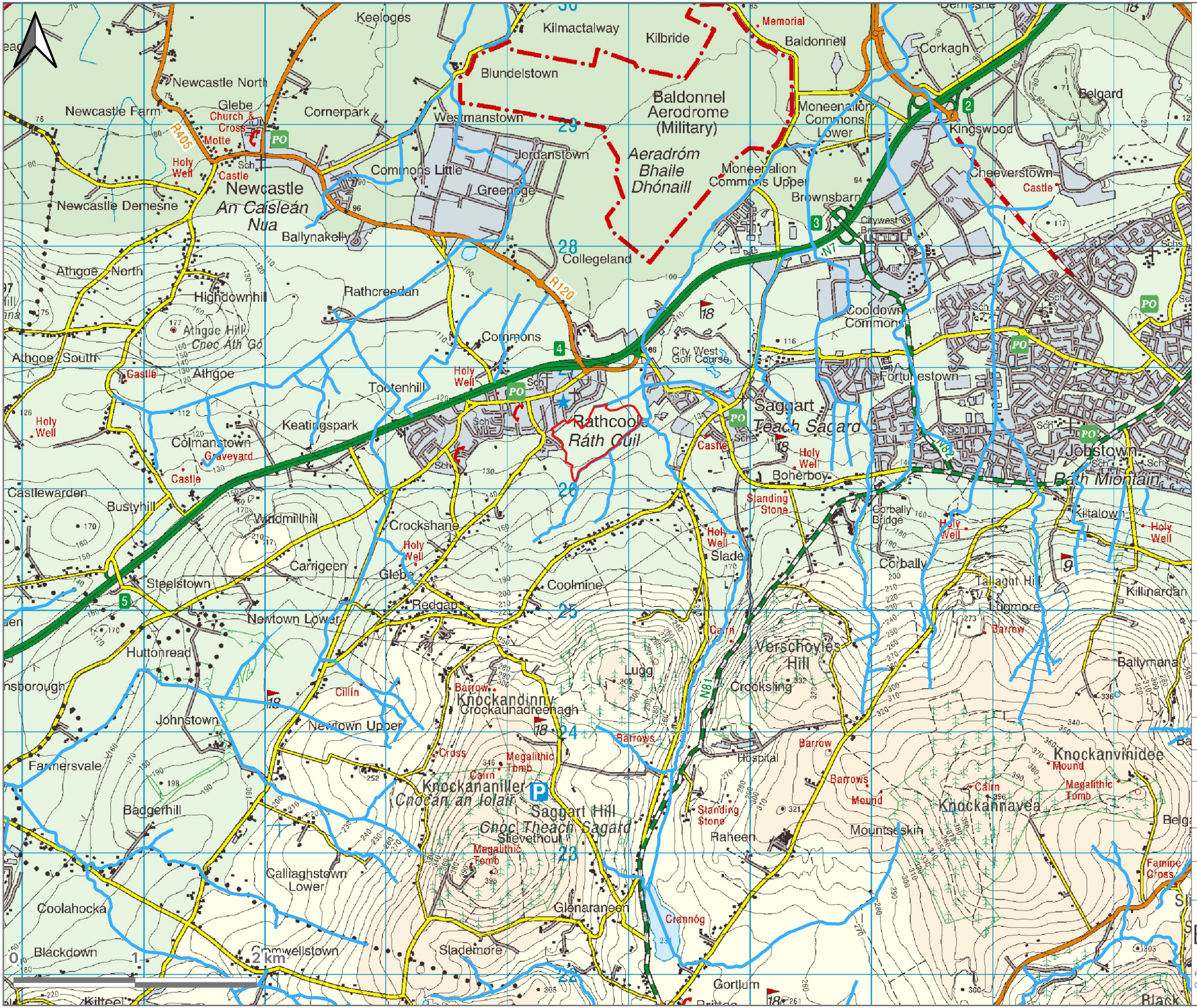
Project Stage	DRAFT
Project Title	SDCC County Devlopment Plan Stategic Flood Risk Assessment
Drawing Title	SFRA Flood Zone Mapping Sheet 14 of 26

Drawing Number	Project	Originator	Volume	Location	Type	Role	Number
	SDSFRA	ROD	EWE	SW_AE	DR	ENV	40014

Scale (A1)	Date:	Job No:	Rev:
1:6,000	April 2021	20.126	

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

Figures


Legend:
Rathcoole Woodlands
EPA River Network
Newcastle North
Newcastle Farm
Glebe
Church & Cross
Motte
Cornerpark
Kilmactalway
Kilbride
Blundelstown
Baldonnell Aerodrome (Military)
Aeradróm Bhaile Dhónaill
Memorial
Baldonnell
Corkagh
Belgard
Kingswood
Moneenalion Commons Lower
Moneenalion Commons Upper
Cheeverstown Castle
Brownsbarn
Westmanstown
Jordanstown
Commons Little
Greenogue
Ballynakelly
Newcastle
An Caisleán Nua
Newcastle Demesne
Holy Well
Castle
Collegeland
Athgoe North
Highdownhill
Athgoe Hill
Cnoc Ath Gó
Athgoe South
Rathcreedan
Commons
Cooldown Commons
City West Golf Course
Fortunestown
Tootenhill
Athgoe
Keatingspark
Colmanstown
Graveyard
Rathcoole
Ráth Cuil
Saggart
Teach Sagard
Jobstown
Bath Mhóntain
Boherboy
Standing Stone
Castlewarden
Bustyhill
Windmillhill
Crockshane
Corbally Bridge
Corbally
Tiltalown
Slade
Carrigeen
Glebe
Steelstown
Coolmine
Redgap
Newtown Lower
Huttonread
Tallaght Hill
Tigmore
Killinardan
Barrow
Cairn
Verschoyles Hill
Crooksling
Lugg
Ballymana
Cillin
Knockandinny
Crockaunadreenagh
Newtown Upper
Johnstown
Barrows
Cross
Megalithic Tomb
Hospital
Knockanvinidee
Mound
Farmersvale
Knockaniller
Cnocán an Iolair
Saggart Hill
Cnoc Theach Sagard
Shevethoul
Raheen
Mountseskin
Knockannavea
Famine Cross
Badgerhill
Calliaghstown Lower
Coolahocka
Glenaraneen
Crannóg
Blackdown
Cromwellstown
Slademore
Gortlum
Kiltee
R405
R120
N7
N81
N82
0
1
2 km
(c) Ordnance Survey Ireland
All RIghts Reserved
License No.EN0080522
Figure 1: Site Location
Date: February 2022
Project: 1972
Author: COR
Scale: 1: 40,000
Client: Four Districts Woodland Habitat Group
Project: Hydrological Assessment
Location: Rathcoole, Co. Dublin
ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE

Legend:

- Rathcoole Woodlands
- EPA River Network
- Drainage Networks

Figure 2:	Aerial View
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 5,000
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE

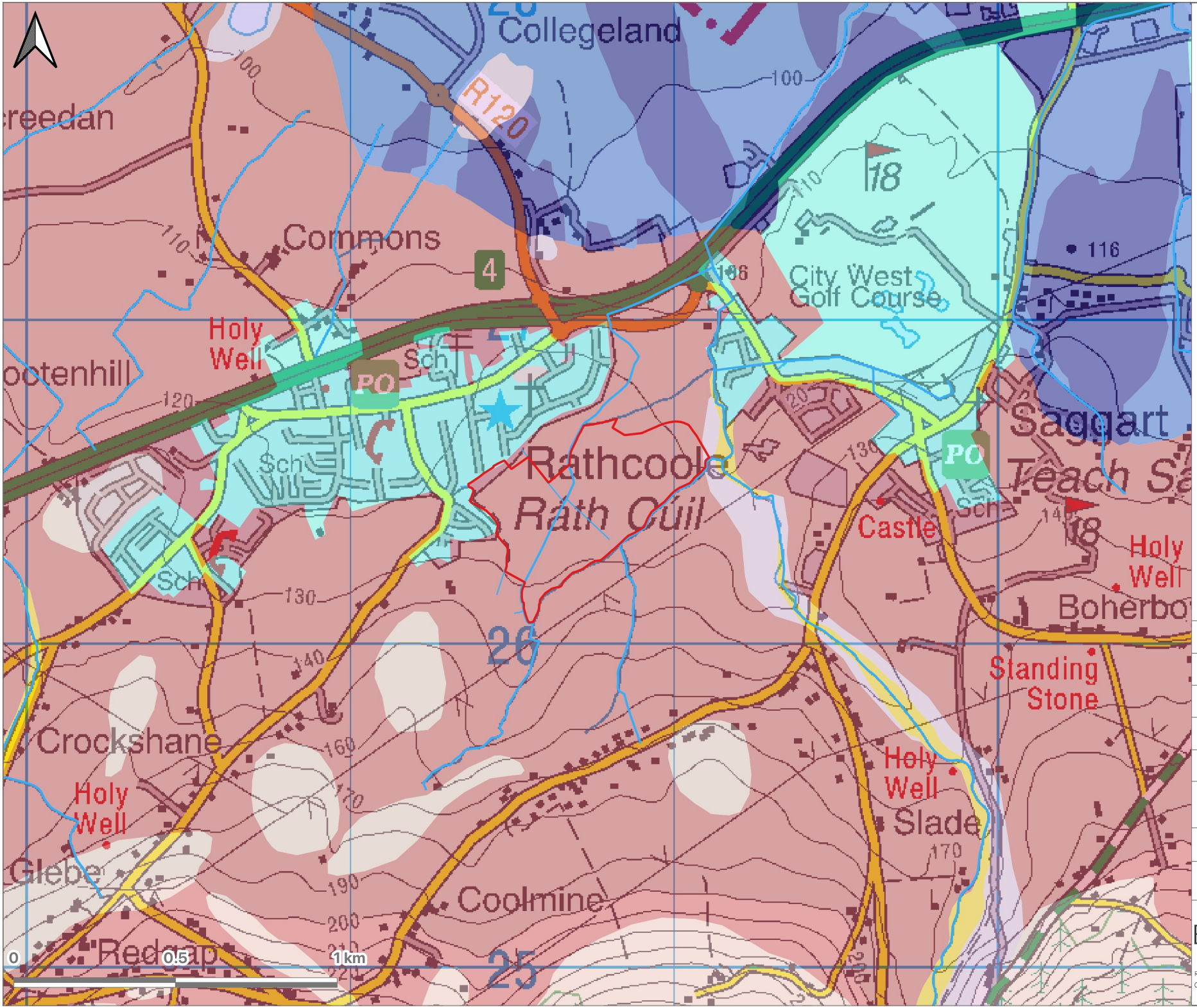
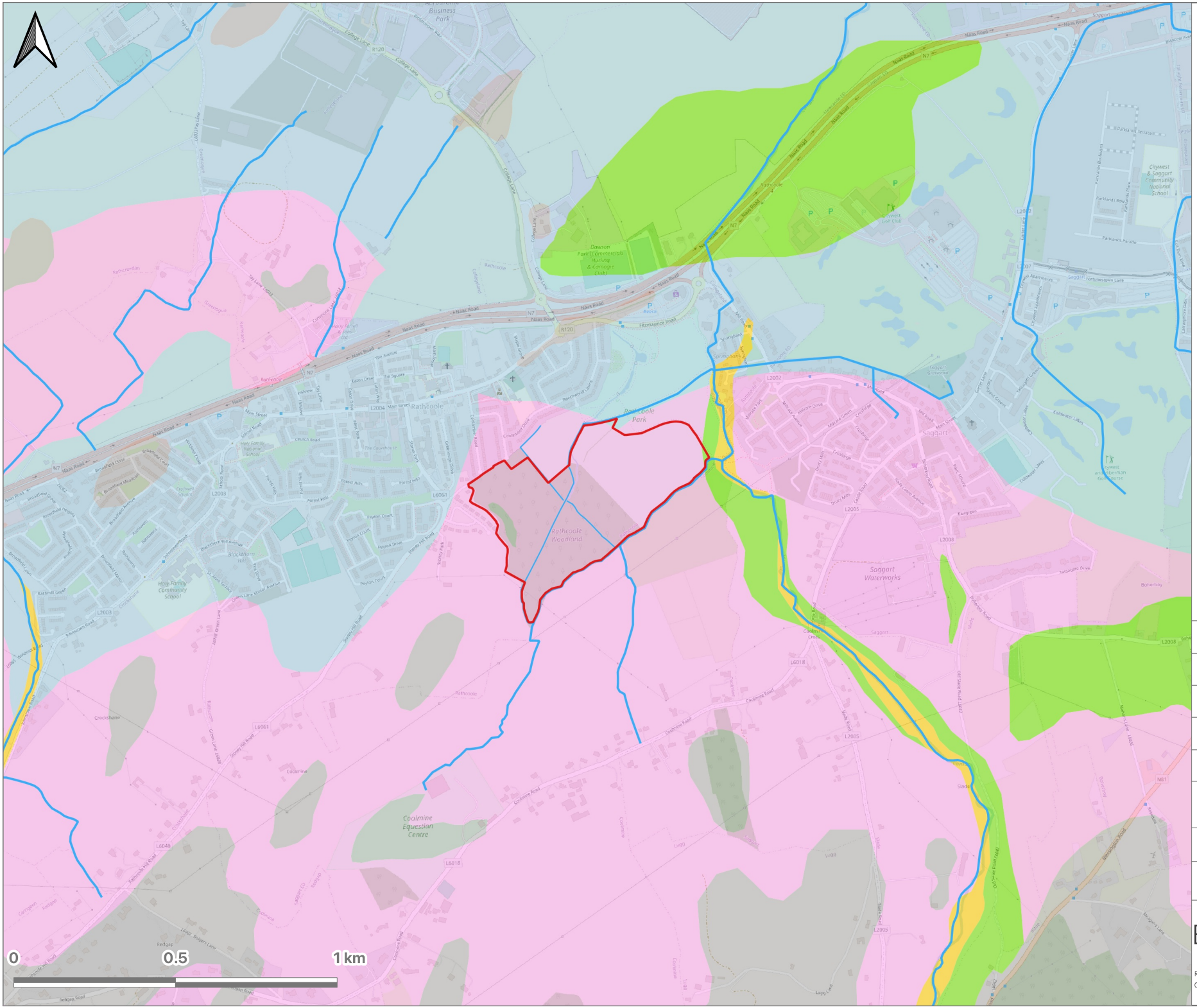


Figure 3:	General Soils Classification
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 5,000
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE



Legend:

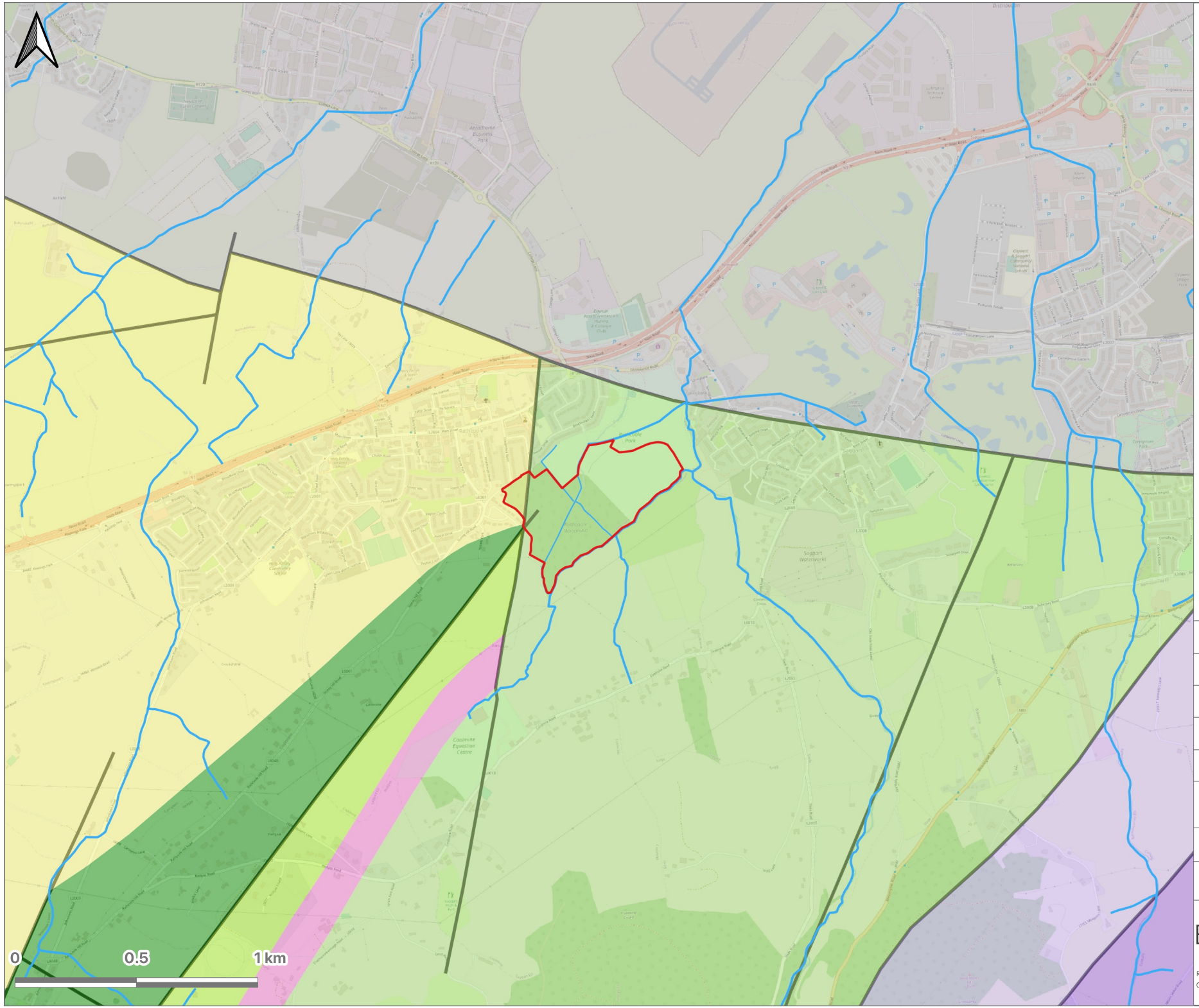
- Rathcoole Woodlands
- EPA River Network
- Drainage Networks

Quaternary Sediments

- Alluvium
- Bedrock outcrop
- Limestone Gravels
- Limestone till
- Till derived from Lower Palaeozoic sandstones and shales

Figure 4:	Quaternary Deposits
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 15,000
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE



Legend:

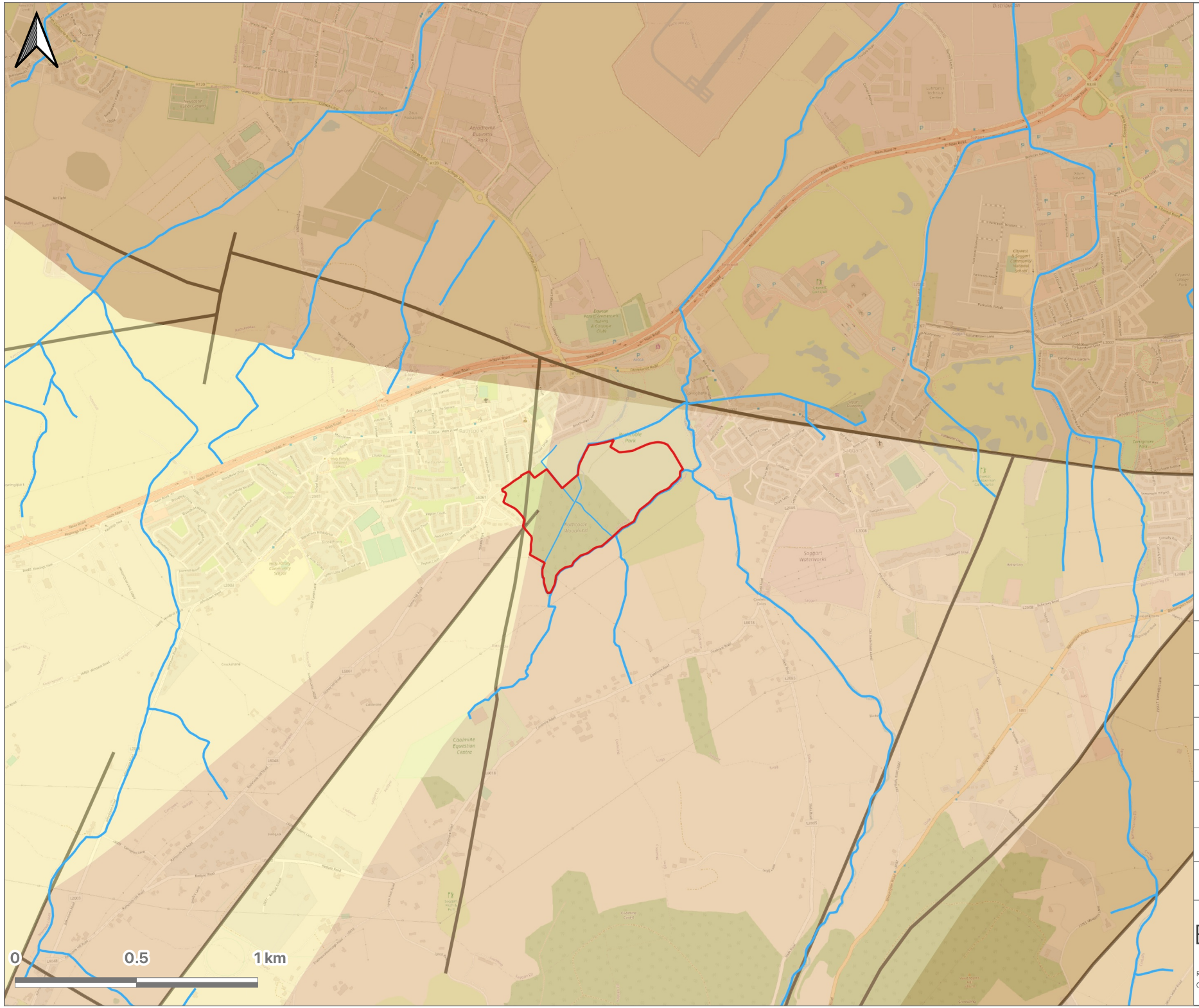
- Rathcoole Woodlands
- EPA River Network
- Drainage Networks

Bedrock Units

- Aghfarrell Formation
- Butter Mountain Formation
- Carrighill Formation
- Glen Ding Formation
- Lucan Formation
- Pollaphuca Formation
- Slate Quarries Formation
- Tipperkevin Formation
- Structural Faulting

Figure 5:	Bedrock Geology
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 20,000
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE



Legend:

- Rathcoole Woodlands
- EPA River Network
- Drainage Networks
- Structural Faulting

Bedrock Aquifer

- Locally important, moderately productive only in local zones (Ll)
- Poor, unproductive except for local zones (Pl)
- Poor, generally unproductive (Pu)

Figure 6:	Aquifer Classification
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 20,000
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE

Legend:

- Rathcoole Woodlands
- 25 inch Watercourses
- 25 inch Springs
- 25 inch Wells

Figure 7:	25" OSI Map Data
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 10,000
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE

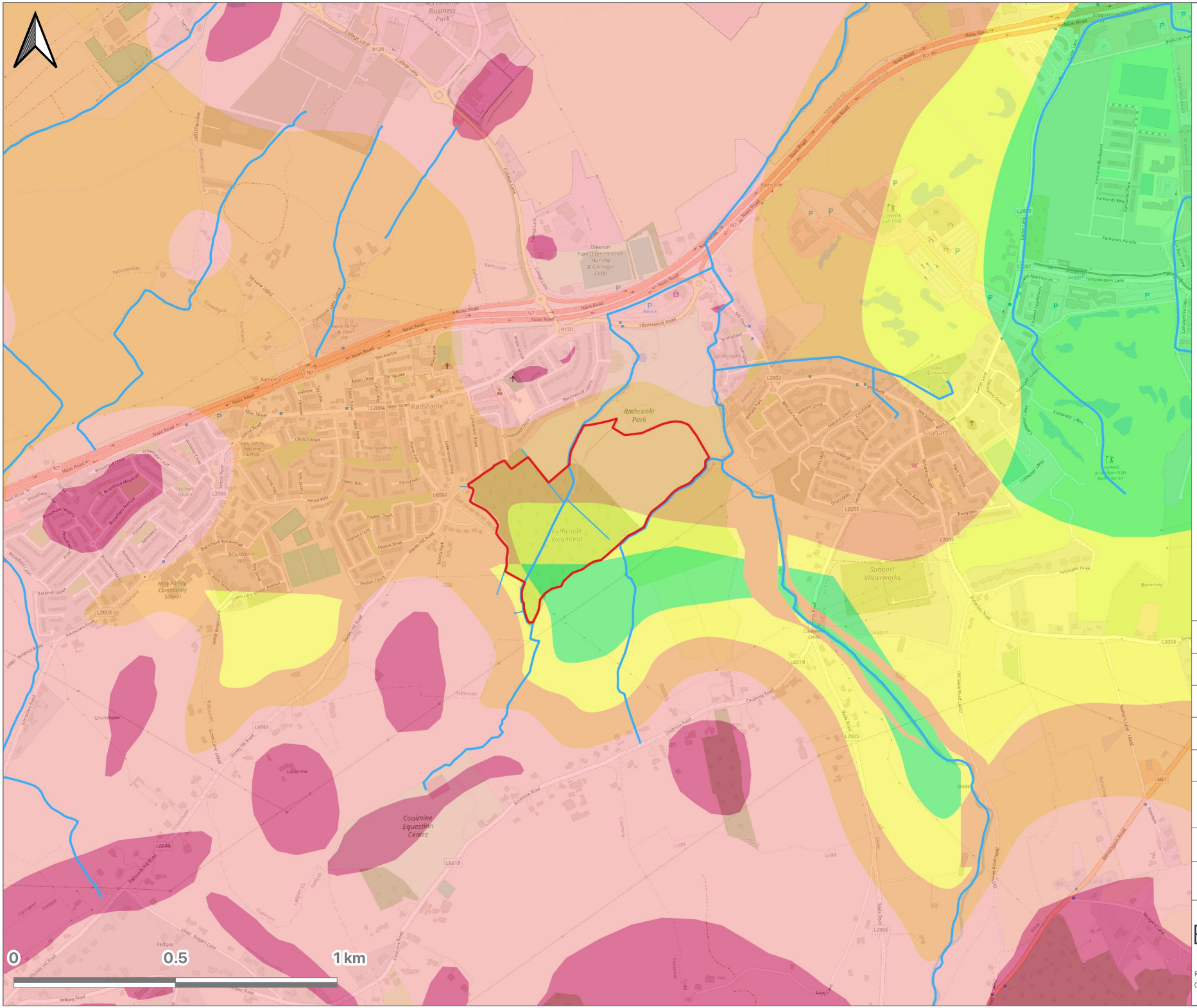


Figure 8:	Groundwater Vulnerability
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 15,000
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE

Legend:

- Rathcoole Woodlands
- Current Watercourses
- Drainage Networks

Figure 9:	Groundtruthed Channels
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 7,500
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE

Legend:

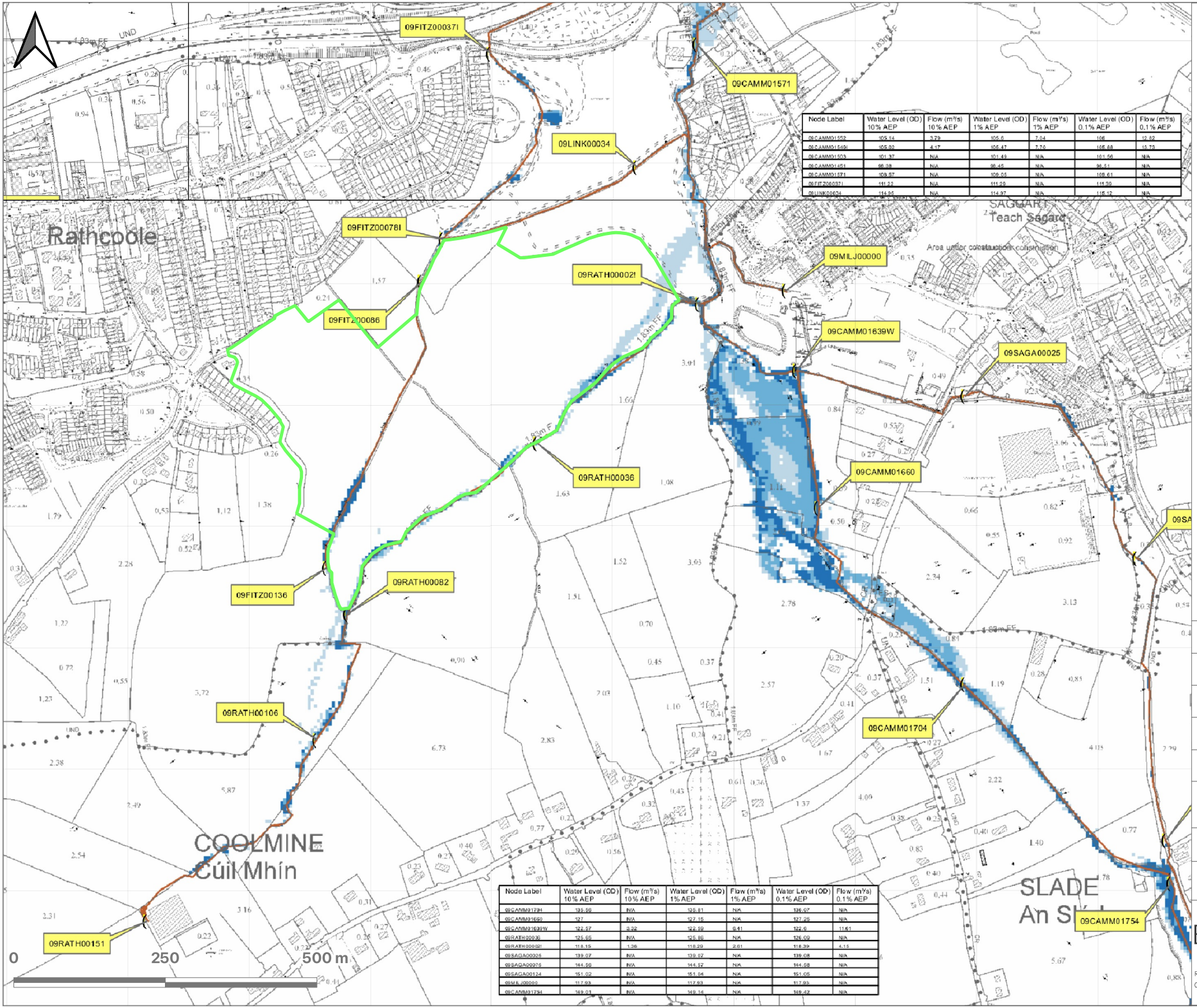
- Rathcoole Woodlands
- Current Watercourses
- Drainage Networks

Catchments

- Camac
- Coolmine/Rathcoole
- Fitzmaurice

Figure 10:	Catchments
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 15,000
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE



Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09CAMM01552	105.14	3.79	105.6	7.04	106	12.82
09CAMM01549	105.02	4.17	105.47	7.76	105.88	13.78
09CAMM01503	101.37	N/A	101.49	N/A	101.56	N/A
09CAMM01451	96.38	N/A	96.45	N/A	96.51	N/A
09CAMM01571	108.57	N/A	108.05	N/A	108.61	N/A
09FITZ00037I	111.22	N/A	111.28	N/A	111.39	N/A
09LINK00034	114.95	N/A	114.97	N/A	115.12	N/A

Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09CAMM01704	133.59	N/A	135.81	N/A	136.07	N/A
09CAMM01699	127	N/A	127.15	N/A	127.25	N/A
09CAMM01639W	122.57	3.32	122.59	6.41	122.6	11.61
09RATH00036	125.65	N/A	125.86	N/A	126.09	N/A
09RATH00002I	118.15	1.36	118.29	2.61	118.39	4.15
09SAGA00025	139.07	N/A	139.07	N/A	139.08	N/A
09SAGA00075	144.56	N/A	144.57	N/A	144.58	N/A
09SAGA00124	151.02	N/A	151.04	N/A	151.05	N/A
09MILJ00000	117.93	N/A	117.93	N/A	117.93	N/A
09CAMM01754	149.01	N/A	149.14	N/A	149.42	N/A

Legend:

Rathcoole Woodlands

Figure 11:	OPW CFRAM Map
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 8,000
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

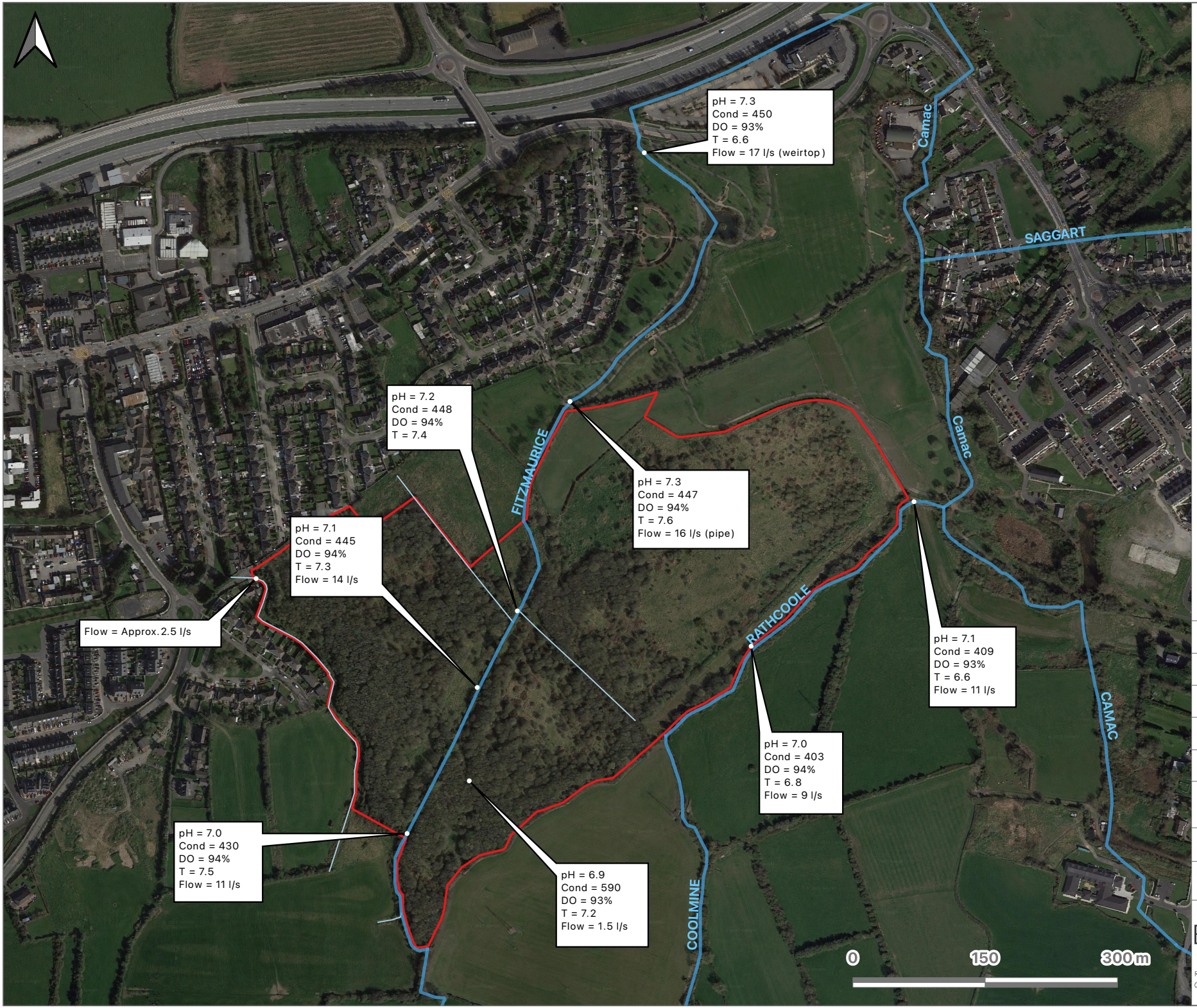
ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE

Legend:

- Rathcoole Woodlands
- Current Watercourses
- Drainage Networks
- SWL, mOD 21/01/22
- GWL, mOD 21/01/22

Figure 12:	SW & GW Levels
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 7,500
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE

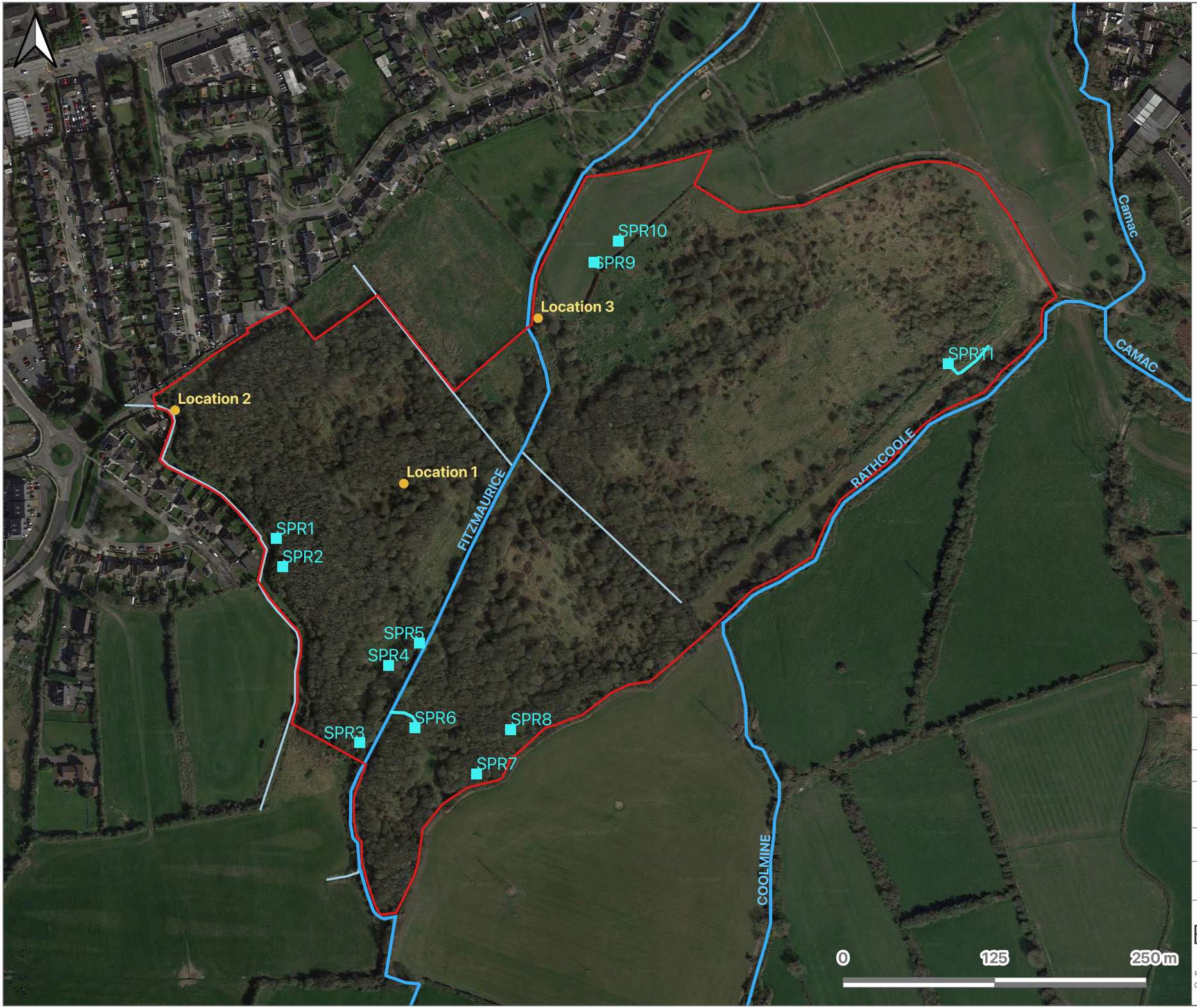


Legend:

- Rathcoole Woodlands
- Current Watercourses
- Drainage Networks

Figure 13:	Field Chemistry & Flows
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 5,500
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE



Legend:

- Rathcoole Woodlands
- Stream
- Drainage Networks
- Calcareous Springs (Wilson & Denyer)
- Observed Ponded Areas (Four Districts Woodland Habitat Group)

Figure 14:	Wilson & Denyer 'Springs'
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 4,000
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

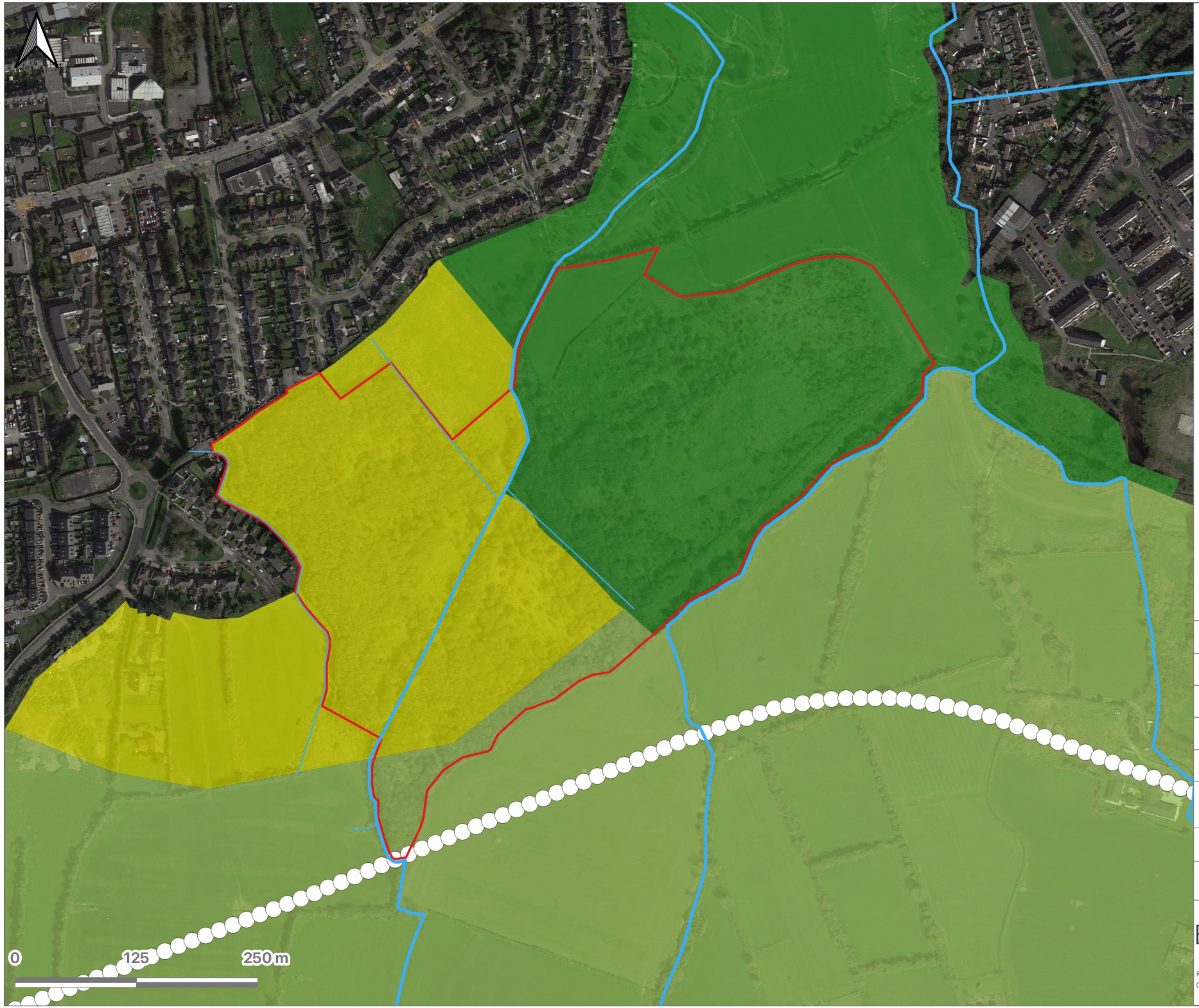
ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE

Legend:

- Rathcoole Woodlands
- River Network
- Drainage Networks
- Habitat Linear
- Calcareous Springs (Wilson & Denyer)
- Reed & Large Sedge Swamps
- Wet Grassland
- Wet Willow-Ash-Alder Woodland
- Dry Meadows & Grassy Verges
- Immature Woodland
- Mosaic

Figure 15:	Habitat Map (Wilson,2021)
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 8,500
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE



Legend:

- Rathcoole Woodlands
- EPA River Network
- CFRAM Watercourses

SDCC Draft Zoning Elements

- OS: Provide Open Space Amenity
- Res-N: Provide New Residential
- RU: Agriculture/Rural Amenity
- Long Term Road Proposal

Figure 15:	Draft SDCC Zoning Map
Date:	February 2022
Project:	1972
Author:	COR
Scale:	1: 5,000
Client:	Four Districts Woodland Habitat Group
Project:	Hydrological Assessment
Location:	Rathcoole, Co. Dublin

ENVIROLOGIC
HYDROGEOLOGICAL · HYDROLOGICAL CONSULTING
ROBERTSON HOUSE, UNIT 49 BALDOYLE IND EST, D13
01 8322176 · 087 2024695 · INFO@ENVIROLOGIC.IE