

Memorandum of Understanding

Partnership Agreement between Natural Resources
Wales and South Wales Caving Club

Dated: 11 July 2019

MEMORANDUM OF UNDERSTANDING between Natural Resources Body for Wales (NRW) of 29 Newport Road, Cardiff, CF24 0TP and South Wales Caving Club (SWCC), of 1-10 Powell Street, Penwyllt, Pen-y-Cae, Swansea SA9 1GQ

1. Aim and purpose of the Memorandum

- 1.1. This Memorandum records the understanding of NRW and SWCC (including their advisory body, Ogof Ffynnon Ddu Cave Advisory Group (OFDCAG)) in respect of their common objectives relating to matters of mutual interest. This Memorandum is primarily in the relation to access, use and the conservation of the cave and all karst and natural features within the Ogof Ffynnon Ddu (OFD) cave SSSI, which includes the OFD National Nature Reserve (NNR) and all entrances to OFD. Additionally, this Memorandum will be scheduled with a cave access agreement for provisions for access to, use and conservation of Tooth Cave (Parkwood, Gower) which forms part of the wider Parkmill Woodlands and Llethrid Valley SSSI. This will be added in due course. It sets out a framework through which the parties seek to enhance the delivery of mutual objectives by sharing knowledge and information.
- 1.2. This Memorandum recites the responsibilities of the parties and establishes the general principles for their cooperation.
- 1.3. This Memorandum shall be effective from the date recorded above and it will be regularly reviewed in accordance with paragraph [6] of this Memorandum.
- 1.4. This Memorandum is to be read in conjunction with the following documents (which form annexes 1 – 7 of this Memorandum):
 - OFDCAG Terms of Reference (Annex 1)
 - OFD Access and Entry: Conditions, Procedures and Rules (Annex 2)
 - Policy on Digging and the Use of Explosives (Annex 3)
 - Duties of Cave Wardens (Annex 4)
 - Radon in OFD (Annex 5)
 - Tooth Cave Access Agreement and Entry: Conditions, Procedures and Rules (to be reviewed and added following the first review and appraisal meeting held every 6 months)

2. Roles and functions of the signatories

2.1. NRW

2.1.1 NRW is a Welsh Government Sponsored Body. NRW's purpose is to ensure that the natural resources of Wales are sustainably maintained, enhanced and used, now and in the future.

2.1.2 The roles and responsibilities include, amongst others:

- A principal adviser to the Welsh Government on the environment and natural resources and a statutory consultee to planning applications per year;
- Acting as a regulator using over 40 different sets of regulation including those for designated sites, the marine environment, forestry and the nuclear, waste and water industries;
- A land manager for 7% of the land area of Wales including woodlands, water and National Nature Reserves;
- An environmental operator managing over 120,000 hectares of woodland and maintaining almost 2,000 miles of flood defences;
- As an incident responder dealing with approximately 9,000 reported incidents and issuing flood warnings to over 100,000 people;
- Promoting enterprise activities on the estate it manages, including energy projects and the harvesting and marketing of timber

2.2. SWCC

2.2.1. SWCC is an un-incorporated private members' club based in the Swansea Valley. The objects of SWCC are set out in club's Constitution as follows:

- The discovery, exploration and survey of caves,
- The scientific study and research in caves and cave entrances,
- The conservation of caves,
- The support of an effective cave rescue organisation,
- The furtherance of any other activities associated with caving.

2.2.2. The Policies of SWCC include:

- To be a respected voice in matters speleological.
- To support the wider community where practical and maintain friendly relations with its neighbours.
- To be a responsible landlord and landowner.
- To support and promote the safe, and responsible, enjoyment of the outdoor and underground environment through the voluntary ethos of club based caving and other 'not for profit' organisations which are open to all who have the necessary interest and initiative.

3. Principles of working together

3.1. NRW and SWCC each recognise the independent remit of the other party and the requirement for each party to exercise its own discretion in all decision making, but will aim to:

- collaborate and cooperate where appropriate in the achievement of their shared and respective objectives in the access to, use and conservation of OFD cave SSSI and NNR;
- engage in open discussion in areas of mutual interest to achieve their respective objectives in contributing to the sustainable management in the access to, use and conservation of OFD cave SSSI and NNR;
- collaborate and cooperate where appropriate in the achievement of their shared and respective objectives in the access to, use and conservation of Tooth Cave within the Parkmill Woodlands and Llethrid Valley SSSI;
- operate in a transparent way while undertaking their responsibilities;
- involve and work with each other in areas of shared interest or concern, with other relevant delivery partners included, where appropriate and agreed;
- share and keep each other informed of any data, research, collected information or other work or development that either party believes would be helpful to the other in connection with the decisions or activities of either party, taking account of their respective obligations under the General Data Protection Regulation and the Data Protection Act 2018 and subject to any intellectual property or confidentiality restrictions placed on the parties; explore further opportunities to develop shared working practices and reduce duplication of effort. Where such opportunities are identified, the specific terms on which the parties will share working practices will be negotiated and agreed outside the terms of this Memorandum; and
- seek to deliver consistent and coordinated messages when working together on projects and when working with Government, delivery partners and the public.

4. Status

- 4.1 NRW, as a Welsh Government Sponsored Body, is accountable to Ministers and the Welsh Government, as set out in the Establishment Order for the Body and the agreed Governance Framework. The parties recognise that any relevant requirements in these governance arrangements take precedence over this Memorandum.
- 4.2 The parties agree that this Memorandum is not legally binding between them and does not create any form of partnership or legal rights or obligations. It is however a statement of their shared intention to work together in a spirit of co-operation in pursuance of the matters outlined above.
- 4.3 Nothing in this Memorandum of Understanding shall fetter the discretion of NRW and its duties to be impartial, fair to all affected persons and to exercise (and be seen to exercise) its functions in accordance with the requirements of relevant legislation at all times. Accordingly, nothing in this Memorandum is to be taken as limiting or affecting in any NRW's exercise of its powers and duties.

5. Announcements

The parties will endeavour to keep each other informed in advance (taking into account confidentiality and other obligations owed to third parties) of any forthcoming significant public of policy announcements on material matters of mutual interest including, for example only, early notice of non-restricted significant business developments and non-routine asset sales.

6. Review and appraisal of the Memorandum

6.1. In addition to ad hoc meetings as business dictates, NRW and SWCC will also meet approximately every six months (these meetings, to be held Monday - Friday, may be in person, via video conferencing or telephone conferencing) ("the Biannual Meeting") to review the shared wider strategic context of the environments in which they operate and explore opportunities for the improvement of joint working practices.

6.2. This Memorandum will be reviewed:

(a) at the Biannual Meeting; and

(b) whenever substantial changes occur to the policies, external relationships and structures of the parties concerned, or to the interaction between governments within the UK;

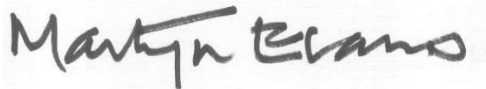
and any amendments to this Memorandum consequent upon those reviews will be incorporated into it by the parties by mutual agreement.

7. Primary Contacts

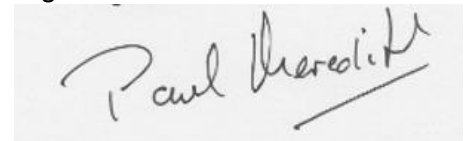
NRW and SWCC will each nominate a primary contact. These primary contacts will be responsible for encouraging a fluent and (where the commercial interests of the parties allow) transparent relationship between NRW and SWCC, resolving difficulties and monitoring the smooth operation of this Memorandum. Substitute primary contacts, for both NRW and SWCC, should be agreed in the event of absences.

8. Signatories

8.1. The parties agree to the terms set out in this Memorandum.



Signature



Name Martyn Evans

Paul Meredith

Position Head of Operations South West

Chairman

Natural Resources Body for Wales

South Wales Caving Club

Annex 1 - OFDCAG Terms of Reference

1. This Document

This document should be read in conjunction with the Memorandum of Understanding which sets out the relationship between National Resources Wales (NRW) and South Wales Caving Club (SWCC) in relation to Ogof Ffynnon Ddu (OFD).

2. Role of the Group

- a) The Ogof Ffynnon Ddu Cave Advisory Group (OFDCAG) advises and assists Natural Resources Wales and the South Wales Caving Club in all matters concerning access to and use of the caves within the Ogof Ffynnon Ddu cave SSSI.
- b) The OFDCAG's primary concern is the conservation of the cave and all-natural features within it. The cave presents an unrivalled range of passage and formation types that attract both scientific and sporting cavers.
- c) For the reasons set out in (b) above it is the role of the OFDCAG to:
 - advise on access to the cave and on the access rules
 - advise on conservation measures
 - support and work with the NRW in its role as landowner of the NNR
 - and as regulatory authority over the whole of the SSSI
 - support and work with SWCC in their role as landowner of part of the SSSI and as a source of caving expertise.
- d) Because of the location of SWCC headquarters within the SSSI, SWCC facilitates access to the whole of the cave SSSI. For insurance reasons and by agreement with NRW, the access controlling body for OFD is SWCC. Permits for access to the cave are issued by SWCC.
- e) The OFDCAG provides the forum at which policy and other matters are discussed, taking account of the interests of cavers and the interests and obligations of and to NRW and SWCC.
- f) The OFDCAG, in advising NRW and SWCC, aims to provide consistent advice in relation to caving interests in the OFD cave SSSI, based on accumulated knowledge and experience of the area, of relationships with neighbouring landowners and with other caving bodies, and of circumstances and access requests that call for special consideration.

3. Group Structure

a) Chairman

The Chairman of OFDCAG is appointed by SWCC Committee. In the case of unavoidable absence from a meeting the Secretary may nominate a substitute Chairman. In addition to chairing meetings, unless NRW are in attendance (see 6b below), the role of the Chairman is to provide formal feedback to NRW, along with representation of the interests of NRW (submitted either verbally or in writing prior to OFDCAG meetings) which can include associated advice on policy and other relevant issues.

b) Secretary

The Secretary of OFDCAG is appointed by the SWCC Committee. The role of the Secretary is in the administration of meetings, preparation of minutes, filing of all relevant documents, dealing with relevant correspondence, and provision of advice on relevant policy issues.

c) Appointment of Chairman and Secretary

Annually, immediately following the SWCC AGM, SWCC Committee appoints the Chairman and Secretary. In doing so, SWCC Committee should seek, as far as is reasonable, to provide continuity and to ensure that the persons nominated have sufficient background knowledge to fulfil the requirements of these roles.

If a vacancy for Chairman or Secretary arises at any other time SWCC Committee shall appoint a replacement

d) Ex-officio Positions

A key role of the ex-officio representatives from SWCC is to ensure active information flow between the SWCC Committee and the OFDCAG. The following are ex-officio members of the OFDCAG:

- SWCC Conservation Officer,
- SWCC Fixed Aids Officer,
- SWCC Permit Secretary

e) Substitutes for Ex-Officio Members

If they are unable to attend or if a conflict of interest arises, the above ex-officio members and other representatives may be replaced at OFDCAG meetings by substitutes nominated on a meeting-by-meeting basis by the bodies they represent.

f) Additional Caver Representation

Whilst SWCC has obligations on behalf of NRW, and as landowners with its own rights and obligations, for reasons of transparency, bodies with other interests in the cave are also represented. The Cambrian Caving Council is entitled to send a representative.

In addition, given that many clubs visiting the cave are from outside Wales, all clubs that hold and have held an annual OFD permit for at least the previous three consecutive years shall be invited to seek representation on the OFDCAG. Clubs wishing to be represented shall be entered into a random ballot from which three are selected. Those clubs will then

each be invited to nominate a representative to serve for a period of three years, after which a new ballot will be held.

g) South & Mid Wales Cave Rescue Team Representative

The presence of a representative of the team that has responsibility for the area helps resolve potential conflicts of interest between conservation, access, and the requirements of cave rescue.

h) Cave Wardens

Cave Wardens are members of the OFDCAG, ex-officio, to provide input on issues affecting the cave, gained during the performance of their voluntary duties. In relation to execution of their duties as Wardens (see associated document: Duties of Cave Wardens), they are responsible directly to the OFDCAG Chairman.

There should normally be no more than ten Cave Wardens.

Nominations for Cave Wardens may be made by the OFDCAG or by SWCC Committee. Warden appointments are made by SWCC Committee. A brief statement as to why the person is considered suitable to undertake the duties of a Warden must be included in the relevant OFDCAG and SWCC minutes. Only persons covered by BCA insurance are eligible to hold the position of Cave Warden.

All nominations, if ratified, will be added to the Cave Warden personnel list, which is maintained by the OFDCAG Secretary, and also passed to NRW as a notification of appointment. Wardens wishing to resign their position should do so in writing directly to the Secretary of the OFDCAG.

A Cave Warden shall normally serve the OFDCAG for a period of three consecutive years unless the Chairman deems there is an overriding reason for extending the term of service.

[Note that the ex-officio positions in 3d above do not automatically become Wardens and neither do representatives of other organisations.]

4. Scientific Research in the Caves

Proposals for research should be made to the Secretary of the OFDCAG who shall inform both SWCC Secretary and NRW. The decision on approval rests with SWCC, taking account of the advice of the OFDCAG, with NRW input, and is subject to SSSI compliance.

5. Management Plan

- a) The OFDCAG shall co-operate with NRW and SWCC in the maintenance of the Cave Management Plan for the Reserve and the remainder of the SSSI.
- b) The OFDCAG shall work with NRW and SWCC to ensure that proper consent is in place for potentially damaging operations over the whole of the OFD SSSI.

6. Meetings of the OFDCAG

- a) The OFDCAG will meet in May or June (the 'Summer Meeting') and in November or December (the 'Winter Meeting'). The Chairman and Secretary may agree to call additional meetings provided members of the Committee are given notice in writing, by email or otherwise, a minimum of four weeks prior to the intended date of the meeting, or two weeks in the case of unexpected issues that are particularly urgent.
- b) For each meeting there shall be a quorum of six that must include at least one ex-officio representatives of SWCC. In addition, the NRW shall be invited to send a representative to attend and observe each meeting and to provide advice on the current NRW position. The NRW representative is not entitled to vote
- c) At the meetings, brief reports are to be presented by the Chairman, Secretary, the SWCC Permit Secretary and the SWCC Conservation Officer. There should be an update from the SWCC Fixed Aids Officer confirming that regular checks have been carried out and highlighting any issues that need to be drawn to the attention of the Group.
- d) The OFDCAG may make decisions concerning only the caves within the OFD SSSI and not the land surface. Such decisions require a simple majority of those present and voting. All decisions are subject to landowner approval and compliance with SSSI requirements.
- e) At meetings, the results of each vote taken shall be recorded and included in the minutes. The minutes shall be circulated to all parties concerned within a reasonable period following the meeting.
- f) Between the regular meetings, the Chairman and Secretary may, together, deal with urgent business that in their opinion does not require a meeting to be called. In doing so, they must endeavour to consult with all other members of the OFDCAG by email or other appropriate means. Such matters and any resulting decisions must be reported at the next meeting for inclusion in the minutes.

7. Changes to these Terms of Reference

- a) These Terms of Reference should normally be reviewed every three years in a process involving NRW, SWCC and the OFDCAG but changes may be suggested at any time.
- b) The OFDCAG is bound by the interests and obligations of NRW and SWCC. Consequently, all changes to these Terms of Reference require only the formal approval of NRW and of SWCC Committee.
- c) Any changes suggested by the OFDCAG should be passed to SWCC Secretary for consideration by SWCC Committee in conjunction with NRW.

8. Associated Documents

The following documents are to be read in conjunction with these Terms of Reference:

- OFD Access and Entry: Conditions, Procedures and Rules
- Policy on Digging and the Use of Explosives
- Duties of Cave Wardens
- Radon in Ogof Ffynnon Ddu

9. Freedom of Information

These Terms of Reference and associated documents, minutes of meetings and any other key documents are to be publicly available via an appropriate website with hard copies held in the SWCC library.

10. Assets

The OFDCAG owns neither funds nor property of any kind. Any required expenditure in relation to the cave is the responsibility of either SWCC or NRW, or both, and is subject to their agreement as appropriate. Proposals for expenditure should be passed to SWCC Secretary in the first instance.

Annex 2 - OFD Access and Entry: Conditions, Procedures and Rules

1. These Procedures apply to all parts of and all entrances to Ogor Ffynnon Ddu (OFD) and are to be read in conjunction with the Terms of Reference of the Ogor Ffynnon Ddu Cave Advisory Group (OFDCAG) (Annex 1).
2. By agreement with NRW, the access controlling body for OFD is the South Wales Caving Club (SWCC); the SWCC Permit Secretary administers access, taking advice from the OFD Cave Advisory Group (OFDCAG). The entire cave is a Site of Special Scientific Interest (SSSI) and a large part of it is a National Nature Reserve. Access to the cave is subject to the obligations placed upon the landowners by its special status.
3. Entrances to the cave are gated and permits for entry are obtained from the SWCC Permit Secretary by following the procedures set out here. Conservation of the cave and its flora and fauna is a priority and cavers are expected to act responsibly and adhere to the entry conditions and rules.
4. Access is available to members of *bona fide* caving clubs who have read, and are prepared to abide by, the Conditions of Entry and Rules published by NRW and SWCC. *Bona fide* caving clubs are defined as those affiliated to the British Caving Association or another appropriate national or international body.
5. Applications for permits must be made by an officer of the club and be received by the Permit Secretary at least two weeks prior to the proposed caving trip. Applications may be made either by email to ofdaccess@hotmail.co.uk or by post, in which case a stamped addressed envelope would be appreciated.
6. The maximum permitted party size is 6 people, including the leader, and individual parties must remain separated in the cave. A permit covers a single party of up to 6 people. If more than 6 people from the applying club will be in the cave at the same time, then multiple permits must be requested.
7. Permit holders may obtain keys to the cave from SWCC headquarters at weekends or, during the week, from recognised key holders.
8. The Permit Secretary shall have absolute discretion in interpreting these conditions and may refuse a permit, in which case the applicant will be informed of the reason for refusal. The applicant may appeal, in writing, to NRW and SWCC or via the secretary of the OFDCAG.
9. There is a facility for Annual Permits to be issued to clubs that have demonstrated a regular and conscientious interest in Ogor Ffynnon Ddu. Applications for Annual Permits should be made to the Permit Secretary. Clubs who have a rapid turnover of members (such as University caving clubs) are not normally granted annual permits.
10. Access to the Columns area is restricted in the interests of conservation. Parties may visit the Columns only when a Cave Warden is present. Wardens will normally be available for visits to the Columns between noon and 3pm on the Sundays of Easter, May Day, Spring and August Bank Holidays, and New Year's Day, for which there will be a rota of Wardens. Parties wishing to visit the Columns at these times do not need to make any prior arrangements but should make themselves known to a Warden by 10 am on the day. Parties must ensure that they have their own leaders; Wardens do not act as leaders for visiting parties.
11. The 'Entry Conditions and Rules' are listed on the reverse of each permit.

Annex 3 - Policy on Digging and the Use of Explosives

This policy is to be read in conjunction with the Terms of Reference of the Ogof Ffynnon Ddu Cave Advisory Group (OFDCAG) (Annex 1).

1. Digging and the use of explosives are recognised as valid techniques for cave exploration, however the conservation of the known cave is of paramount importance.
2. This policy applies to the use of all explosive materials and expansive chemicals, regardless of whether or not their use requires a licence.
3. The cave is a Site of Special Scientific Interest (SSSI), which places specific obligations on its owners and those undertaking operations within, or related to, the cave.
4. Each SSSI has a formal list of Operations Likely to Damage to the Special Interest. The owners and occupiers of that land have a legal requirement not to carry out or permit others to carry out operations on this list unless they have obtained formal SSSI Consent from Natural Resources Wales (NRW). Whilst NRW consider it helpful to have a system providing delegated authority to specific person(s) with expert knowledge (so as to consider, vet and control proposals for digging and use of explosives) the legal requirement for SSSI Consent remains on the owners. Applications in the first instance may be submitted to the Secretary of the OFD Cave Advisory Group (OFDCAG).
5. The principal owners of the land within the OFD SSSI are NRW and the South Wales Caving Club. By agreement with NRW, SWCC controls access to the entire cave, with advice from the OFDCAG.
6. Permission is to be obtained from SWCC and NRW, via the OFDCAG, before explosives are used or digging commences on the surface or underground. NRW specialists (e.g. geologist, ecologist etc.) may give permission in straightforward cases, provided an appropriate SSSI Consent is held by the appropriate landowner.
7. The permission will be given to a specific person or persons who shall be responsible for their own safety, and that of all others in the vicinity. To comply with the legal requirements in relation to SSSI status, the person(s) authorised must not permit anyone to carry out an operation on SSSI land unless the owner or occupier of that land has a current SSSI Consent, as above.
8. Any permission given is on the basis that the person has knowledge of and complies with all relevant legislation.
9. The type and quantity of explosive and the technique used should aim to reduce extraneous damage to a minimum.
10. All digs must be kept in a safe condition and no explosives may be left in the cave or on the SSSI. Safety measures must be agreed via the OFDCAG prior to the dig commencing.
11. Any failure of a charge to detonate fully must be dealt with in accordance with recognised safety procedures. If the misfire has not been rectified and the site is left unsafe when vacated, the situation must be reported immediately to the OFDCAG Secretary or SWCC Permit Secretary who will endeavour to ensure that normal access to the area is prevented until the misfire has been dealt with successfully by a suitably qualified person.

12. A record must be kept, by the authorised person, of the location and nature of all operations permitted under this policy, and must be available to NRW, SWCC and OFDCAG on request.

Annex 4 - Duties of Cave Wardens

This document is to be read in conjunction with the Terms of Reference of the Ogof Ffynnon Ddu Cave Advisory Group (OFDCAG) (Annex 1).

The Cave Wardens are responsible to the Chairman of the OFDCAG. Their duties relate to all caves within the OFD SSSI and are as follows:

1. To monitor and report on conservation matters relating to caves.
2. In consultation with the SWCC Conservation Officer and the OFDCAG, to mark off sensitive areas of the cave (normally with tape) and to maintain existing markers and other conservation aids.
3. As far as is reasonably practicable to rectify damage, in consultation with SWCC Conservation Officer and the OFDCAG.
4. To remove litter.
5. To attempt to ensure those using the cave adhere to the current rules of access and use.
6. To participate in or otherwise contribute to meetings of the OFDCAG.
7. To be present during visits to the Columns, and other areas of restricted access, arranged according to the appropriate procedures. Wardens' responsibilities do not extend to acting as leaders for parties.
8. To observe the condition of fixed aids within the cave, to report any concerns and, if requested, to assist with their maintenance.
9. To undertake such other duties as may be reasonably expected to protect and preserve the scientific and sporting aspects of the cave.

Annex 5 – Radon in OFD

The presence of radioactive radon gas in cave and mines has long been recognised and it is accepted that exposure to any radioactive source should be as limited as possible. Presently, there is no indisputable proof that cavers' health has been adversely affected by exposure to radon daughters during caving activities. However, research in uranium mines worldwide has shown that a risk does exist. It was in response to this risk that the National Caving Association (NCA) commissioned their document: *Radon Exposure During Underground trips: a set of Guidelines for Caving and Mine Exploration*. This provides a background to the problem; an assessment of the risk from exposure to radon in caves and mines; a brief review of the legislation; and guidance on meeting legal requirements. Whilst no professional caving activities take place within the Ogof Ffynnon Ddu system, it is emphasised that the legal requirements are quite different from those undertaking recreational activities. Professionals, and those in positions of responsibility, are advised to refer to the Ionising Radiations Regulations (1999) and the information in the NCA Guidelines (1996), which is to be considered in conjunction with the requirements of the *Cave Instructor Certificate* and the *Local Cave and Mine Leader Assessment Scheme* both administered by the NCA.

The measurement of received radiation dose is a complicated issue for several reasons. Normally, the quantity of radon in air is measured by detecting the number of alpha particles emitted from a given volume of air over a period of time. There is a very complex relationship between this quantity and radon concentration. In working mines, the potential dose has historically been measured in a unit known as the Working Level. The formal SI unit of activity is the Becquerel (Bq), a Becquerel being the disintegration of one atom in one second. More conveniently, activity concentrations per cubic metre (Bq m^{-3}) are used to describe the concentration of radioactivity in air. The approximate relation between the Becquerel and the Working Level is taken to be 1 WL is equivalent to 3700 Bq m^{-3} of radon at equilibrium. However, the equilibrium factor, F, is a time-consuming parameter to measure and its value varies considerably (e.g. Kendall et al., 1994). For this reason and the fact that relatively robust radon monitors could be used, the NRPB recommendation to recreational cavers was to use concentration in a time integrated manner quoted as $\text{Bq m}^{-3} \text{ h}^{-1}$ (e.g. Kendall & Dixon, 1997). In this, and the advice given by NCA (1996), an equilibrium factor of 0.5 was used as a representative value for all calculations. However, the recent legislation (IRR, 1999) now requires that dose should be measured in milliSieverts (mSv) which simplifies matters as it gives a direct conversion from concentrations of radon gas in Bq m^{-3} without recourse to a measured equilibrium factor. This conversion formula is:

$$\text{Dose (mSv)} = \frac{(\text{Concentration } \text{Bq m}^{-3}) \times \text{duration}}{254000}$$

The ICRP recommendation for the general public is an annual dose not to exceed 1 mSv (ICRP 1993). Therefore, using the calculated mean concentrations obtained from the Ogof Ffynnon Ddu system and the separate traverses of the main parts of the system (Friend & Gooding 2001), expected doses have been calculated from the above formula (Table 1). It must be understood that for the most part the concentration measurements were made in open parts of the cave system, on frequently used routes. It is possible that in remote parts of the system that have poor ventilation, concentrations may be higher than those used here. Using the highest mean concentration of 3094 Bq m^{-3} obtained from OFD II as the constant value for a trip of 10 hours duration, the expected dose is thus in the order of 0.12 mSv. Therefore, it would take about 80 hours, or approximately 8 trips of 10 hours duration in the

cave system at this concentration, to reach the recommended dose of 1 mSv. As the vast majority of caving trips in the system is closer to 5 hours long, the total number of trips taken to reach the ICRP level, at maximum concentration, would be nearer to 16. Most average cavers go underground about twice a month, therefore, using the maximum OFD system mean (2844 Bq m⁻³, Table 2), would take say 90 hours underground to get to the recommended 1mSv limit. These calculations are all based on the highest values obtained and, assuming that the concentration encountered will not continually be at such high levels, there is a margin of error on the side of safety.

Apart from caving trips, most recreational cavers will otherwise only encounter radiation from radon in a background or domestic setting. Geographically, background radon concentration over Britain varies considerably, from known high areas such as Cornwall with an average annual dose of 6.3 mSv, to low areas such as London where the dose is about 1.2 mSv. In a domestic dwelling the average concentration is taken as about 20 Bq m⁻³ which equates to an annual dose of about 1 mSv (O’Riordan, 1990), the ICRP recommendation for members of the public (ICRP 1993). This average radon concentration of 20 Bq m⁻³ for a dwelling can be compared with the values for the SWCC HQ, a building constructed on and from the local limestone. A range of 70 Bq m⁻³ (winter) to 170 Bq m⁻³ (summer) was obtained (Friend & Gooding 2001). Using these values as 6 monthly averages, this crudely leads to an average concentration of 120 Bq m⁻³. This value is towards the recommended action level in Britain set at 200 Bq m⁻³, (based on three-monthly average measurements in two rooms) corresponding to an annual dose of 10 mSv (O’Riordan, 1990).

Therefore, whilst not minimising the importance to limit any exposure to radiation, the exposure to radon likely to be encountered in the Ogof Ffynnon Ddu cave system can be individually controlled so that it is within the current NRPB recommendations without unduly hampering underground activities.

Table 1. Estimated doses calculated from the statistical means of winter and summer radon concentration in the Ogof Ffynnon Ddu system and for the individual traverses of parts of the system. Data from Friend & Gooding (2001).

	Winter			Summer		
	Bq m ⁻³	mSv*	hours†	Bq m ⁻³	mSv*	hours†
OFD whole system	2318	0.09	110	2844	0.11	89
separate traverses						
OFDI – Cwm Dwr	1946	0.08	131	3094	0.12	82
OFD II	2876	0.11	88	2667	0.11	95

*A trip of a nominal 10-hour duration is used in the calculation. To calculate the likely dose for any trip, divide the estimated dose by 10 and multiply by the duration in hours.

† Number of hours required to reach the 1 mSv dose limit (to nearest whole hour).

References

Friend, C.R.L. & Gooding, T. 2001. Seasonal variations in the concentration of radon in the Ogof Ffynnon Ddu system, Penwyllt, South Wales and estimates of doses to recreational cavers. *Journal of Environmental Radiation*. **48**, 45-57.

International Commission on Radiological Protection (ICRP) 1993. Protection against Radon 222 at home and at work. *ICRP 65, Annals of the ICRP*, **23**, No. 2.

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