

BMOE 6003: Landscape and Sustainable Recreation; Anthony Burns

Reflective Fieldwork Management Plan: Llyn-y-Frân. word count 2739

Table of contents

BMO 6003: Landscape and Sustainable Recreation; Anthony Burns.....	1
Reflective Fieldwork Management Plan: Llyn-y-Frân 2737.....	1
Summary.....	1
Introduction.....	2
Theories of Site Management.....	2
Limits of Acceptable Change (LAC).....	2
Carrying Capacity.....	2
Recreation Opportunity Spectrum (ROS).....	2
Ecosystem Services Approach.....	3
Site Significance and Use.....	3
Site Issues.....	3
General Management Strategies.....	6
Following on from the interview with the management at Llyn-y-Frân the following general strategies are suggested which not only align with best practices in sustainable recreation but also will allow the site to further develop as a recessional site whilst maintaining its SSSI status:.....	6
Specific Strategies.....	7
Conclusion.....	8
References.....	9

Summary

Llyn-y-Frân is a rural multi-use outdoor centre in Wales, operating within a Site of Special Scientific Interest (SSSI) and managed by Welsh Water. This management plan integrates fieldwork and theoretical frameworks, including Limits of Acceptable Change (LAC), Carrying Capacity (CC), the Recreation Opportunity Spectrum (ROS), and the Ecosystem Services Approach (ESA) to guide sustainable recreation while conserving the site's ecological value.

Key issues include environmental degradation, user conflicts, dog control, waste, and infrastructure challenges. Mitigation measures such as zoned use, improved signage, fencing, adaptive trail use, and ranger-led education have been introduced. Strategies include surfacing bike trails, managing footpath access seasonally, and enhancing collaboration with emergency services and local councils.

Ongoing monitoring, adaptive management, and community engagement are central to ensuring both visitor satisfaction and long-term environmental protection. Llyn-y-Frân is presented as a model for sustainable outdoor recreation within protected landscapes.

Introduction

Llyn-y-Frân is a multi-use outdoor centre located in a rural part of Wales and is recognised as a Site of Special Scientific Interest (SSSI). The centre supports a diverse range of recreational activities, including sailing, mountain biking, and walking. As the reservoir is owned and managed by Welsh Water, recreational developments here are coupled with an obligation to protect the ecological significance of the area. This management plan reflects on fieldwork conducted at the site and evaluates a series of sustainable recreation strategies. It incorporates established frameworks such as Limits of Acceptable Change (LAC), Carrying Capacity, and the Recreation Opportunity Spectrum (ROS) to develop a balanced approach that ensures positive visitor experiences while conserving the site's unique landscape. Through the critical use of theoretical models and site-specific data, this plan aims to deliver a responsible and adaptive framework for the long-term sustainability of Llyn-y-Frân.

Theories of Site Management

A combination of theoretical frameworks underpins the management of Llyn-y-Frân, ensuring that strategies are both evidence-based and context-specific. These have been adapted to be site-specific.

Limits of Acceptable Change (LAC)

LAC provides a structure for defining and monitoring thresholds of environmental and social impact. Managers identify indicators (e.g. trail erosion or biodiversity decline), define acceptable levels, and monitor changes over time (Stankey et al., 1985). For Llyn-y-Frân, these include the local otter population, tree cover and how many people can be using the site at any given time.

Carrying Capacity

The concept of carrying capacity recognises that physical, ecological, social, and managerial limits exist for sustainable use (Shelby and Heberlein, 1986). At Llyn-y-Frân, this includes the number of users on trails, car park capacity, and noise levels near sensitive habitats. As discussed earlier it is difficult for Llyn-y-Frân to completely control how many people are on-site, due to the public rights of way. Limited car parking and the restrictions and oversight for ecological sustainability does reduce the potential users. People cannot have fires if they are camping, and dogs need to be on a lead, which turns away other potential customers.

Recreation Opportunity Spectrum (ROS)

The ROS classifies recreation areas along a spectrum from highly developed to wilderness (Driver and Brown, 1978). Llyn-y-Frân falls between "Rural" and "Roaded Natural", supporting the use of zoning to separate high- and low-impact activities.

The Recreation Opportunity Spectrum (ROS) has been defined by Virden and Knopf (1989) as the relationships that “exist between outdoor recreation activity styles, desired psychological experiences, and preferred environmental settings”. This has been developed into a spectrum defining areas from highly developed to wilderness (Driver and Brown, 1978). Llyn-y-Frân can be assessed as falling between a rural and a structured natural area. Using this spectrum, it can be suggested that Llyn-y-Frân's management can be improved by clearly breaking the site into different areas based on the way the ROS is applied to the facets of the site.

Ecosystem Services Approach

This theory highlights the ecological, economic, and cultural services provided by natural environments (Millennium Ecosystem Assessment, 2005). Llyn-y-Frân's status as a reservoir and SSSI highlights the need for recreation to support, not compromise, these services.

These frameworks help guide decisions such as where to place new trails, how to mitigate user conflict, and when to intervene due to ecological thresholds being breached.

Site Significance and Use

This report focuses on the outdoor adventure aspects of the site; however, because Llyn-y-Frân is also a Site of Special Scientific Interest (SSSI) and a water reservoir managed by Welsh Water, additional restrictions are in place. The site began its transition into a recreation hub in 2017, requiring extensive upgrades such as new buildings and trail systems. Welsh Water's investment aims to ensure high standards in outdoor recreation while promoting environmental stewardship (BBC News, 2017). Today, Llyn-y-Frân offers a wide range of outdoor activities, including a purpose-built mountain biking park, walking trails, and watersports facilities (Llyn-y-Frân Lake in Pembrokeshire, 2025). These developments are intended not only to provide economic sustainability but also to diversify public perceptions of Welsh Water by aligning recreation with conservation (Welsh Water, 2025).

Site Issues

The multifaceted nature of Llyn-y-Frân creates several challenges regarding sustainability. Increasing popularity has intensified pressures on both the environmental and social aspects of the site. The SSSI designation imposes use restrictions, and one major point of contention involves campers wanting to light fires, which contravenes site policy. Additionally, many dog walkers allow dogs off-lead, despite signage and policies, causing ecological damage and raising safety concerns.

Conflicts between different user groups are evident, including issues between locals and tourists and among cyclists, walkers, and anglers. Instances of disagreement have occurred, such as disputes over infrastructure changes, with some arguing that it's always been this

way so the changes being made are not valuable. The disputes between the cyclists and walkers are more immediate as collisions either between participants or pets is a safety issue that can potentially lead to serious injury.

Environmental disrespect remains a persistent issue. Despite the presence of bins and signage, waste accumulation has grown exponentially with rising visitor numbers. The site's public rights of way limit control over visitor numbers and behaviour, making safety regulation and planning more difficult. Trail degradation due to mountain biking, especially on steeper routes, has also contributed to faster land erosion.

The local pigeon population has also led to disagreements between the outdoor recreational department and the SSSI rangers. Pigeon excrement on equipment risks infection, gear failure and making the activity look less professional. This is most evident in the water store shed where the pigeons have decided to roost.

Historical management challenges persist. A lack of coordination with emergency services, including confusion over responsibility during rescues near the dam, illustrates former oversight failures. Visitors are not allowed to swim in the lake, but enforcement is difficult even with signage and ranger patrols. Petrol-powered boats are banned to protect the water quality; fishing is permitted only with licenses and electric-powered motors.

Finally, some of the buildings and site layout present usability problems, having been designed without direct input from outdoor managers. Retrofitting for recreational use has required ongoing adaptation, further complicating day-to-day site operations.

Mitigation Measures

To address these challenges, Llyn-y-Frân has implemented several mitigation strategies. To combat environmental degradation, paved and boardwalk sections have been added to heavily used trails to reduce erosion. These mitigation strategies use Limits of Acceptable Change (LAC) as well as an Ecosystem Services Approach (ESA) to monitor and conserve the landscape.

Specific dog-walking areas have been fenced off to allow off-lead exercise while protecting more sensitive zones. Rangers and instructors are encouraged to ask the owners of the dogs to put them back on the lead if they notice users' dogs off their leads. Encouraging dog owners to keep their dogs on a lead as well as providing a fenced space for them to be allowed off their leads using ESA and LAC, unintentionally limiting the potential users making the carrying capacity (CC) less.

Rangers and instructors actively inform visitors about swimming and boating rules, and the site has increased the presence of multilingual signage to improve communication. Improved signage also directs visitors to appropriate trail difficulty levels, reducing the

chance of user conflicts or accidents. The site's isolation from other water systems allows for greater control over who can access the water, with fishing and water access run by Welsh Water, meaning the use of petrol vehicles on the reservoir cannot be used by the public. This helps with ESA conservation as well as the CC of the lake in particular.

Waste management improvements include more frequent bin collections during peak periods, additional bin placements, and educational signage about Leave No Trace principles. Additionally, the outdoor instructors for the site's recreational activities are in charge of cleaning up the activities and the waste caused by the users to keep spaces clean and professional to maintain ESA and LAC.

The management team is working to establish stronger links with local emergency services, ensuring clear responsibilities and communication protocols in the event of accidents, with the fire department now using the dam as a practice site to build familiarity for the rescues that may be required on the site. The mitigation strategies around the dam, where there are two layers of buoys, make the risk of a craft collision minimal. Additionally, more visible rangers are present on the site during the summer 24/7 to ensure that the users and campers are complying with the restrictions on the site. To help the SSSI designation it is essential to utilise ESA procedures and strategies.

In terms of site design, new construction projects are now conducted with greater consultation from outdoor professionals, ensuring future infrastructure is appropriate and sustainable. Meanwhile, adaptive management is guiding changes to trail access and layout, with some paths rotated out of use to allow regeneration. The most used bike park is being paved to combat erosion. Over the last three years, the bike tracks have degraded faster than expected, with one track degrading to the point where it's been reassessed to be a black run, with more signs asking walkers not to use the bike tracks and only bike riders to use the bike trails. Even with the mitigating factors, the erosion of the bike track risks no longer being compliant with LOC and ESA standards. With more interaction between the staff and users, this should improve the tracks.

The centre also maintains close collaboration with Welsh Water departments, helping align water management objectives with recreational goals. This partnership ensures that ecological priorities are not compromised by recreation while allowing visitor access to remain open. With marker buoys outlining where the public has access to the water, the diversification of the site includes SSSI and an outdoor centre and has an incredible Recreational opportunity spectrum (ROS). However, Welsh Water standards tightly controlled for the conservation and sustainability of the site's other priorities.

General Management Strategies

Following on from the interview with the management at Llyn-y-Frân the following general strategies are suggested which not only align with best practices in sustainable recreation but also will allow the site to further develop as a recessional site whilst maintaining its SSSI status:

Zoning: on the site, areas will be defined for separating user groups. Walkers, cyclists, dog walkers and watersports users will be given specific zones with the intention of reducing conflict and minimising damage and wear to the site. These zones help to localise and limit the impact users have on the site, helping tremendously with the carrying capacity (CC), as each zone has their own individual CC allowing for more diverse activities on the site. The zones at Llyn-y-Frân already include two bike parks, walking trails, a specific area for users to access the water as well as provision for future land based activities (rock climbing, axe throwing and archery). Instructors are given responsibility for the cleanliness and general upkeep of the zone they are working in.

Visitor Education: in order to maintain the quality of the site improved signage and training staff to interact with users of the park whenever possible to improve understanding of their impact on the park through their behaviour. The presence of park rangers, as well as instructors, giving environmental knowledge to users through verbal and visual education will also promote greater knowledge of the specific landscape and its flora and fauna.

Monitoring and Feedback: to assess the areas of the park which have the greatest use and require the most careful management digital trail counters can be used to obtain the information. This will show park management the areas with the biggest footfalls. They can also instigate ecological surveys, and visitor feedback tools in order to assess the environmental impact of the users on the park.

Adaptive Management: with greater awareness of the different uses of the park by visitors, it is possible to be adaptive in management decisions to improve the maintenance of the park whilst encouraging outdoor use of the different zones. Management decisions are revisited as new data becomes available, ensuring a flexible, evidence-based response. As a result of adaptive management and monitoring the usability of Llyn-y-Frân, storage of outdoor equipment has been moved to more appropriate locations. Specifically, moving the bike storage to where the wet store was and moving the wet store into a drying room has resulted in much greater efficiency.

Public Engagement: park rangers will be trained to engage with visitors throughout the day. They will inform the local community groups of the changes and the reason for them. These strategies reflect guidance from Manning et al. (2017), who emphasise integrating planning, monitoring, and stakeholder communication in recreation management.

Specific Strategies

To promote sustainable recreation while protecting the site's ecological integrity, several targeted strategies are proposed.

The dedicated dog area will be enlarged. It will be fully fenced and located away from sensitive habitats. This will allow dogs to be exercised off-lead without disturbing local flora and fauna. The aim of this is to reduce the potential stress to ground-nesting birds, especially as the park falls within the SSSI boundaries. Enhancing the dog zone has been shown to reduce conflict in multi-use sites (Natural England, 2014).

The mountain bike park near the entrances is an area of high usage and would benefit from using highly resistant materials or a sacrificial surface that can be maintained over time. Surfacing involves laying down stone aggregate on high-traffic routes or using appropriate surface like hard rubber to tarmac to preserve the land in those areas degrading. This approach improves durability, slows erosion, and prevents the widening of tracks due to user detours around muddy patches. It aligns with the Recreation Opportunity Spectrum (ROS), which encourages managing physical impacts in high-use areas (Clark and Stankey, 1979).

Footpaths can be changed for different times of the year, allowing habitat recovery and path maintenance. Temporarily closing selected paths based on weather patterns and usage intensity should help keep the environment sustainable. Signage and social media updates will inform visitors of closures. This system mirrors the Limits of Acceptable Change (LAC) framework, which advocates monitoring and adaptive trail use to avoid degradation (Stankey et al., 1985).

The Fishing Policy restricts watercraft to electric-only motors and requires permits. This reduces noise and water pollution, benefiting aquatic life and maintaining a peaceful atmosphere. Controlled access through permits also allows data collection on fishing pressure and helps prevent overuse (Environment Agency, 2020).

Ranger-led interpretation, through guided walks and mobile information points, will educate visitors on the site's SSSI status, native species, and sustainable practices. Informal education has been shown to increase pro-environmental behaviour and stewardship (Ham, 2009).

Public Right of Way Management involves partnering with local councils to install user counters and advisory signs along key paths. These tools support data collection for visitor flow analysis and help guide behaviour—such as avoiding shortcuts or wildlife-sensitive areas. Collaborative signage strategies are effective for shaping user behaviour in protected landscapes (Marion et al., 2016).

Each strategy works toward balancing recreational access with long-term environmental sustainability. Actions are evidence-based, scalable, and designed to adapt over time with ongoing site monitoring.

Conclusion

Llyn-y-Frân represents a unique context for the application of sustainable recreation management strategies, situated at the intersection of ecological sensitivity and increasing recreational demand. As a designated Site of Special Scientific Interest (SSSI) and a multi-use outdoor centre, its management requires a nuanced, evidence-based approach that integrates both conservation imperatives and user needs. This report has demonstrated how theoretical frameworks, namely Limits of Acceptable Change (LAC), Carrying Capacity (CC), the Recreation Opportunity Spectrum (ROS), and the Ecosystem Services Approach (ESA) can be applied to inform and guide the continued sustainability of the site.

The mitigation measures and strategic recommendations proposed herein are grounded in both field data and best practice literature. They reflect a commitment to adaptive management, where monitoring, stakeholder engagement, and responsive planning are used to address emergent challenges such as trail degradation, user conflict, ecological disturbance, and infrastructural limitations. In doing so, the management of Llyn-y-Frân aligns with broader principles of sustainable outdoor recreation, in which ecological integrity is maintained without compromising the quality of the visitor experience.

The ongoing viability of the site as both a recreational asset and a protected landscape depends on maintaining a balance between use and preservation. Continued integration of ecological monitoring, public education, and inter-agency cooperation is critical to this aim. As pressures on outdoor spaces increase, Llyn-y-Frân offers a replicable model for sustainable recreation planning within protected environments.

References

- Armitage, D. (ed.) (2007) Adaptive co-management: collaboration, learning, and multi-level governance. Vancouver: UBC Press (Sustainability and the environment).
- Asplund, T.R. and Cook, C.M. (1997) 'Effects of motor boats on submerged aquatic macrophytes', *Lake and Reservoir Management*, 13(1), pp. 1–12. Available at: <https://doi.org/10.1080/07438149709354290>.
- Bainbridge, I., Brown, A., Burnett, N., Corbett, P., Cork, C., Ferris, R., Howe, M., Maddock, Ant, Mountford, Ed and Pritchard, S. (2013) 'Guidelines for the Selection of Biological SSSIs', Joint Nature Conservation Committee [Preprint]. Available at: <https://data.jncc.gov.uk/data/dc6466a6-1c27-46a0-96c5-b9022774f292/SSSI-Guidelines-Part1-Rationale-2013.pdf>.
- BBC News (2017) 'Go ahead for £4m Llys y Fran "great water park" plans', 8 November. Available at: <https://www.bbc.com/news/uk-wales-south-west-wales-41916231> (Accessed: 23 April 2025).
- Brown, P., Driver, B. and McConnell, C. (1978) 'The Opportunity Spectrum -- Concept and Behavioral Information in Outdoor Recreation Resource Supply Inventories: Background In Outdoor Recreation Resource Supply Inventories: Background and Application And Application', *Integrated Inventories of Renewable Natural Resources: Proceedings of the Workshop; January 8-12, 1978; Tuscon, Arizona, General Technical Report-RM(55)*, pp. 73–84. Available at: https://scholarworks.umn.edu/forest_pubs/31.
- Brown, P.J. and Manfredi, M.J. (1982) 'Recreation opportunity spectrum planning: an arid land case', *The George Wright Forum*, 2(2), pp. 25–33. Available at: <https://www.jstor.org/stable/43596946> (Accessed: 23 April 2025).

- Buckley, R. (ed.) (2008) Ecotourism: principles and practices. Wallingford: CABI. Available at: <https://doi.org/10.1079/9781845934576.0000>.
- Clark, R. and Stankey, G. (1979) The recreation opportunity spectrum: a framework for planning, management, and research. Usda forest serv. U.S. Department of Agriculture Forest Service. Available at: https://www.fs.usda.gov/pnw/pubs/pnw_gtr098.pdf.
- Coccossis, H. and Mexa, A. (2017) The challenge of tourism carrying capacity assessment. 0 edn. Routledge. Available at: <https://doi.org/10.4324/9781315240817>.
- Cole, D.N. (2004) 'Environmental Impacts of Outdoor Recreation in Wildlands'. Available at: https://www.researchgate.net/publication/241563091_Environmental_Impacts_of_Outdoor_Recreation_in_Wildlands.
- Eagles, P.F.J., McCool, S.F. and Haynes, C.D. (2002) Sustainable tourism in protected areas: guidelines for planning and management. Gland: IUCN, the World Conservation Union (Best practice protected area guidelines series, 8).
- Gundersen, V., Tangeland, T. and Kaltenborn, B.P. (2015) 'Planning for recreation along the opportunity spectrum: The case of Oslo, Norway', Urban Forestry & Urban Greening, 14(2), pp. 210–217. Available at: <https://doi.org/10.1016/j.ufug.2015.01.006>.
- Hendee, J.C. and Dawson, C.P. (2002) Wilderness management: stewardship and protection of resources and values. 3rd ed. Golden, Colo: Fulcrum Pub.
- Llys-y-frân Lake in Pembrokeshire (2025) Llys-y-Frân - Welsh Water. Available at: <https://llys-y-fran.co.uk/> (Accessed: 23 April 2025).

- Manning, R.E. (2011) *Studies in outdoor recreation: search and research for satisfaction*. 3rd ed. Corvallis: Oregon State University Press.
- Manning, R.E., Anderson, L.E. and Pettengill, P. (2017) *Managing outdoor recreation: case studies in the national parks*. Second edition. Boston: CAB International.
- Marion, J.L. (2016) 'A review and synthesis of recreation ecology research supporting carrying capacity and visitor use management decisionmaking', *Journal of Forestry*, 114(3), pp. 339–351. Available at: <https://doi.org/10.5849/jof.15-062>.
- Millennium Ecosystem Assessment (Program) (ed.) (2005) *Ecosystems and human well-being: synthesis*. Washington, DC: Island Press. Available at: <https://www.millenniumassessment.org/documents/document.356.aspx.pdf>.
- Mosisch, T.D. and Arthington, A.H. (1998) 'The impacts of power boating and water skiing on lakes and reservoirs', *Lakes & Reservoirs: Science, Policy and Management for Sustainable Use*, 3(1), pp. 1–17. Available at: <https://doi.org/10.1111/j.1440-1770.1998.tb00028.x>.
- Newsome, D., Moore, S.A. and Dowling, R.K. (2013) *Natural area tourism: ecology, impacts, and management*. 2nd ed. Bristol: Channel View Publications (Aspects of tourism 58). Available at: <https://www.degruyterbrill.com/document/doi/10.21832/9781845413835/html>.
- Prato, T. (2001) 'Modeling carrying capacity for national parks', *Ecological Economics*, 39(3), pp. 321–331. Available at: [https://doi.org/10.1016/S0921-8009\(01\)00248-8](https://doi.org/10.1016/S0921-8009(01)00248-8).

- Shelby, B.B. and Heberlein, T.A. (1986) Carrying capacity in recreation settings. Corvallis, Or: Oregon State University Press. Available at: <https://osupress.oregonstate.edu/book/carrying-capacity-in-recreation-settings>.
- Sites of special scientific interest: managing your land (2024) GOV.UK. Available at: <https://www.gov.uk/guidance/protected-areas-sites-of-special-scientific-interest> (Accessed: 23 April 2025).
- Stankey, G.H., Cole, D.N., Lucas, R.C., Petersen, M.E. and Frissell, S.S. (1985) The Limits of Acceptable Change (LAC) System for Wilderness Planning. INT-176. USA: United States Department of Agriculture Forest Service. Available at: https://www.fs.usda.gov/rm/pubs_series/int/gtr/int_gtr176.pdf.
- Tonge, J., Ryan, M.M., Moore, S.A. and Beckley, L.E. (2015) 'The effect of place attachment on pro-environment behavioral intentions of visitors to coastal natural area tourist destinations', Journal of Travel Research, 54(6), pp. 730–743. Available at: <https://doi.org/10.1177/0047287514533010>.
- Virden, R. and Knopf, R. (1989) 'Activities, experiences, and environmental settings: A case study of recreation opportunity spectrum relationships', Leisure Sciences, 11(3), pp. 159–176. Available at: <https://doi.org/10.1080/01490408909512217>.
- Water, D.C.W. (2025) Watersource, Dŵr Cymru Welsh Water. Available at: <https://corporate.dwrcymru.com/en/community/environment/our-projects/watersource> (Accessed: 23 April 2025).
- Watson, A.E., Williams, D.R. and Daigle, J.J. (1991) 'Sources of conflict between hikers and mountain bike riders in the Rattlesnake NRA', Journal of Park and Recreation Administration, 9(3). Available at: https://doi.org/https://www.researchgate.net/publication/270049782_Sources_of_conflict_between_hikers_and_mountain_bike_riders_in_the_Rattlesnake_NRA.

- Xiao, S., Jia, L. and Jiang, L. (2012) 'Forest recreation opportunity spectrum in the suburban mountainous region of beijing', Journal of Urban Planning and Development, 138(4), pp. 335–341. Available at:
[https://doi.org/10.1061/\(ASCE\)UP.1943-5444.0000125](https://doi.org/10.1061/(ASCE)UP.1943-5444.0000125).