Lough Talt Regional Water Supply Scheme

Article 6(3) Screening for Appropriate Assessment and Natura Impact Statement

Volume 1

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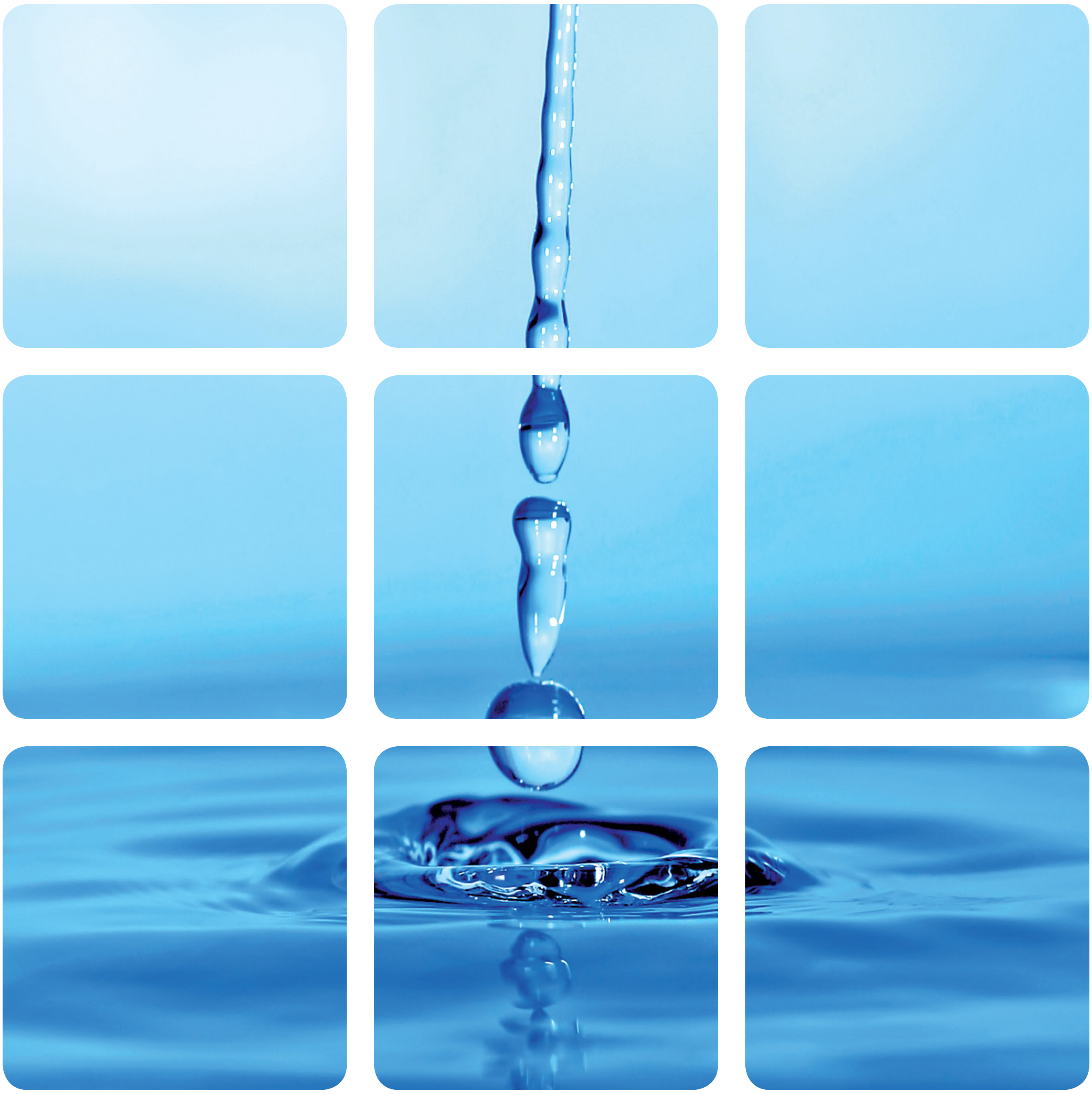

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TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF IMAGES

1 INTRODUCTION

Lough Talt Regional Water Supply Scheme (RWSS) serves a population of 13,663 via a single Water Treatment Plant (WTP) situated in the townland of Gortersluin, Co. Sligo. The supply feeds the town of Tobercurry and a large rural supply area including the villages Annagh, Aclare, Curry, Lavagh, Ballinacarrow, Carroweden, Kilmacteige, Coolaney, Bellaghy and Ballymote.

The source at Lough Talt in south-west Sligo is an upland lake and has been used as the source of raw water for the Lough Talt RWSS since the 1950s. The lake is located on the eastern slopes of the Ox Mountains and is approximately 13km northwest of Tobercurry and 17km south east of Ballina, adjacent to the R294 (Tobercurry to Ballina road). Lough Talt is designated under Lough Hoe Bog Special Area of Conservation (SAC) (Site Code: 000633).

The existing water treatment provision at Lough Talt has significant water quality deficiencies including:

- Inadequate water treatment, resulting in high levels of THM in the treated water; and
- No cryptosporidium barrier and a boil water notice is currently in place.

The current basic water treatment facilities consists of chlorination and fluoridation, which do not address the water quality deficiencies present and is inadequate to provide drinking water which is in compliance with the EU (Drinking Water) Regulations 2014 (S.I. No.122 of 2014) (the “Drinking Water Regulations”).

The Lough Talt water supply scheme has drinking water regulation non-compliance issues with regard to THM exceedances and there is currently a boil water notice in place for the scheme following the detection of cryptosporidium in the treated water coming from the plant. The current level of treatment provides no barrier against cryptosporidium. 140 water samples taken from the supply have been non-compliant with the drinking water regulations over the past 14 years (2004-2018).

The Lough Talt RWSS is on the EPA’s Remedial Action List (RAL) due to “Inadequate treatment for Cryptosporidium”. The EPA issued a Direction to Irish Water on the 15th August 2014 in relation to inadequate disinfection. On the 3rd December 2014 a further Direction was issued by the EPA in relation to exceedances in THM.

Directions issued under Regulation 10(4) of the Drinking Water Regulations refer to failures to meet a quality standard or indicator parameter. Under the legislation, the agreed action plan must be implemented, within one year of the approval date where there is a risk to human health or two years where a risk to human health does not exist.

Furthermore, the European Commission advised the Irish government that it is monitoring the remedial measures being taken in relation to water supplies where there are THM exceedances (EU Pilot 7544/2015/ENVI). THM risk is also a precautionary public health issue, though its impact is thought to be associated with long term exposure rather than immediate impact.

A Boil Water Notice was put in place on Monday 5th February 2018 for the Lough Talt RWSS following the detection of cryptosporidium in the treated water coming from the plant after a routine test.

Both the cryptosporidium and the exceedances in THM issues are important public health risks, with cryptosporidium giving rise to severe gastroenteritis in patients affected and in extreme situations can endanger vulnerable people, where their health is poor in any case. Irish Water has committed to addressing these public health risks in its drinking water supplies as its top priority.

1.1 SCOPE

Irish Water is applying to Sligo County Council for planning permission to upgrade the existing WTP and continue to use this upgraded WTP for a period of 10 years. The purpose of this application is to meet the immediate needs of 13,663 people for safe, clean drinking water. RPS has been commissioned by Irish Water to prepare a Screening for Appropriate Assessment (AA), NIS (Volume 1), Assessment of the Alternative Solutions and Imperative Reasons of Overriding Public Interest (IROPI) (Volume 2) and Compensatory Measures (Volume 3) in view of the conservation objectives of Lough Hoe Bog Special SAC and the River Moy SAC to inform the Article 6 (3) and Article (4) assessments to be conducted by the competent authority for the project.

1.2 STRUCTURE OF REPORT

This report (Volume 1 to 3) provides the scientific evidence in support of the Article 6 (3) and Article (4) assessments to be conducted by the public authority. The process comprises the four stages within the overall procedure and is illustrated in **Figure 1-1** below, which is extracted from the European Commission (EC) (2002) Guidelines on the *Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC.*

The **Screening for AA** is presented in **Volume I Section 4** while the **NIS** is presented in **Volume 1 Section 5**. These assessments comprise the scientific examination of the project on European sites, to identify and characterise any possible implications of the project individually or in combination with other plans or projects in view of the conservation objectives of the sites to inform the AA under Article 6(3) of the Habitats Directive to be carried out by the public authority, Sligo County Council.

If, after consideration of the information in Volume 1, together with any additional information to which it has regard, Sligo County Council determines that it cannot exclude the likelihood of adverse effects on the integrity of a European site, it should consider **the Assessment of Alternative Solutions** information presented in **Volume 2 Section 2**.

The **IROPI** that are being relied upon to indicate that the project should proceed notwithstanding that it may adversely affect the integrity of a European site are presented in **Volume 2 Section 3.** If, after consideration of Volume 2, Sligo County Council determines there is no feasible alternative to the proposed development and there is an IROPI, it should proceed to consider proposed compensatory measures. The proposed **Compensatory Measures** necessary to ensure that the overall coherence of the Natura 2000 network is protected are provided in **Volume 3**. These assessments are to inform the Article 6(4) assessment to be carried out by the public authority, Sligo County Council.

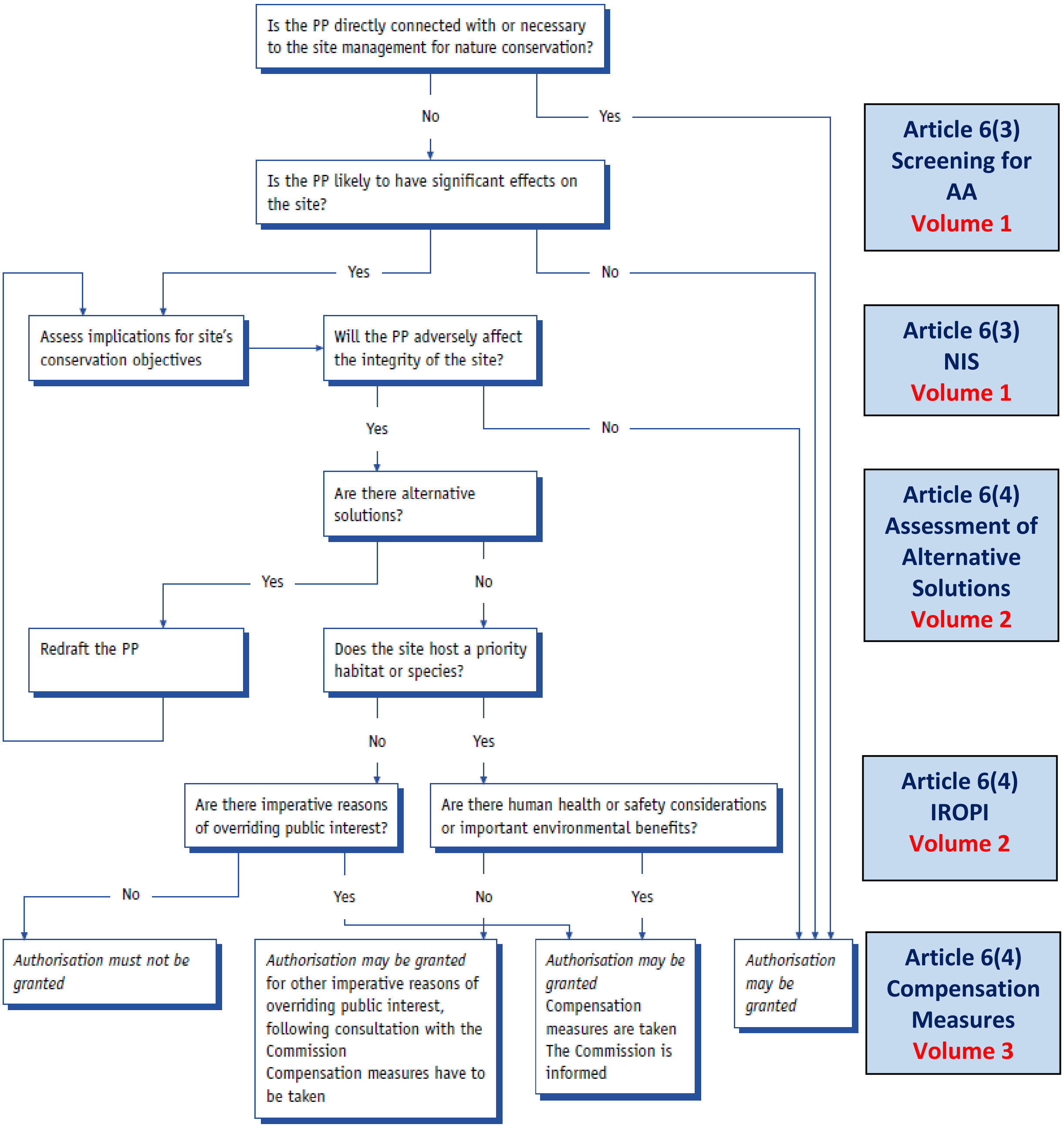


Figure 1-1: Flow Chart of the Article 6(3) and (4) procedure in relation to the Consideration of a Plan or Project Affecting a European Site (EC, 2002[1]).

[1] EC 2002 Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC.

1.3 LEGISLATIVE CONTEXT – HABITATS DIRECTIVE

The Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, better known as "The Habitats Directive", provides legal protection for habitats and species of European importance. Articles 3 to 9 provide the legislative means to protect habitats and species of Community interest through the establishment and conservation of an EU-wide network of sites known as Natura 2000.

The Habitats Directive has been transposed into Irish law by Part XAB of the Planning and Development Act, 2000 - 2015 and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477/2011) as amended.

Habitats Directive, Articles 6(3) and 6(4), set out the decision-making tests for plans and projects likely to have a significant effect on or to adversely affect the integrity of European sites (Annex 1.1). Article 6(3) establishes the requirement for AA:

> *Any plan or project not directly connected with or necessary to the management of the [European] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subjected to appropriate assessment of its implications for the site in view of the site's conservation objectives. In light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.*

Article 6(4) states:

> *If, in spite of a negative assessment of the implications for the [European] site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, Member States shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.*

Natura 2000 sites are defined under the Habitats Directive (Article 3) as a coherent European ecological network of special areas of conservation, composed of sites hosting the natural habitat types listed in Annex I and habitats of the species listed in Annex II, shall enable the natural habitat types and the species' habitats concerned to be maintained or, where appropriate, restored at a favourable conservation status in their natural range. In Ireland these sites are designated as European Sites and include Special Protection Areas (SPAs), established under the EU Birds Directive (79/409/EEC, as codified by 2009/147/EC) for birds and SACs, established under the Habitats Directive 92/43/EEC for habitats and species.

The responsibility for carrying out the AA process lies with the public authority consenting or permitting a plan or project.

1.4 PLANNING HISTORY

Sligo County Council previously approved a Part 8 proposal for a new WTP in 2009 but this plant was never delivered.

In July 2015, Irish Water applied to SCC for planning permission to construct and operate an interim WTP at Gortersluin, Lough Talt, Co. Sligo, to treat water currently abstracted from Lough Talt and to supply 13,663 people with potable water treated to the required drinking water standards. Further information was requested by SCC in August 2015 and a response from Irish Water was submitted in November 2015.

On the 1st February, 2016 SCC issued a *Notification of Decision to Refuse Permission for the proposed Lough Talt Regional Water Supply Scheme (RWSS) – Interim WTP (*Reg. Ref. 15227*)*.

On the 25th February 2016, Irish Water lodged an appeal with An Bord Pleanála (ABP) against SCCs decision to refuse permission for the WTP development.

A request for further information (*Ref PL 21.246218)* was issued to Irish Water by ABP on the 3rd August 2016, in accordance with Section 132 of the Planning and Development Act 2000, seeking a revised Natura Impact Statement (NIS) to be submitted on or before the 3rd November 2016, incorporating a thorough examination of the impacts of the continued water abstraction on Lough Bog SAC and the River Moy SAC. In April 2017, ABP refused planning permission based on the determination that it could not be concluded that the proposed development, in combination with the water abstraction on which it relies, would not adversely affect the integrity of the Lough Hoe Bog Special Areas of Conservation (SAC) (Site Code: SAC000633) or the River Moy SAC (Site Code: SAC002298) in view of the conservation objectives for those sites.

1.4.1 Water Abstraction

Upgrade works are required at the WTP to provide a consistent supply of potable drinking water to the population served by the Lough Talt RWSS. A resolution to the public health issues at the Lough Talt WTP has been sought for over 10 years (prior to Irish Water being established). In 2006, RPS was appointed by Sligo County Council to prepare a Preliminary Report (PR) for the Lough Talt RWSS. The final version of the PR was completed in August 2008. During the preparation of the preliminary report it was determined that there is no Water Abstraction Order (WAO) in place for the Lough Talt abstraction. The abstraction of water from any lake, river, stream, well, or spring by a sanitary authority (incl. Irish Water) for a public water supply is governed by the Water Supplies Act (1942) which requires a sanitary authority wishing to abstract water for public supply to apply to the Minister (now An Bord Pleanála (ABP)) for a WAO.

Sligo County Council commenced the preparation of a WAO for Lough Talt in 2010 in order to regularise the abstraction that has been ongoing from the lake for over 70 years. Due to the environmental sensitivity of Lough Talt, which is designated as part of Lough Hoe Bog Special Area of Conservation (SAC) (Site Code: 000633) and is proximal to the River Moy SAC (Site Code: 002298), detailed hydrogeological investigations were carried out over the period of 2012 – 2016 to assess the potential impact of the existing abstraction on the integrity of the European sites in view of the conservation objectives for those sites. The hydrogeological investigations concluded that during periods of extended dry weather or drought the lake abstraction operation contributes to the lake level dropping to a level which has an impact on the artesian conditions within the fen, which are the supporting conditions for the habitat of the *Vertigo geyeri* whorl snail which is listed under Annex II of the Habitats Directive (92/43/EEC) and a species of qualifying interest of Lough Hoe Bog SAC.

As a result of the survey data it was concluded that it would be necessary for the abstraction to be reduced by approximately 50% (to less than 4 MLD) during a significant portion of the year (95 days on average) to avoid this impact. The Lough Talt RWSS is an isolated water supply network where the nearest potential replacement large scale water resources are Lough Conn, 30 kilometres to the west of the existing WTP and Lough Gill, 40 kilometres to the north of the treatment plant. It is likely to take up to 10 years to establish a new water source to supply 13,000 people with treated drinking water. Identifying and developing a long term replacement source will involve major abstractions, treatment systems and long distance pipelines, with all of the statutory processes, technical, procurement and budget challenges that such major projects entail. The reduction of the abstraction to this level is therefore not possible as there is no other nearby source to supply the deficit in the short term.

The ecological and hydrogeological investigations have demonstrated that continued abstraction from Lough Talt is not sustainable in the long term and therefore Irish Water will progress establishing a replacement water source.

2 METHODOLOGY

2.1 GENERAL

Both EU and national guidance exists in relation to Member States fulfilling their requirements under the EU Habitats Directive, with particular reference to Article 6(3) and 6(4) of that Directive. The methodology followed in this report to inform the Article 6 assessments has had regard to the following guidance and legislation:

Guidance

- EC, (2000a) *Communication from the Commission on the Precautionary Principle*. Office for Official Publications of the European Communities, Luxembourg;
- European Communities (2000a) *Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC,* Office for Official Publications of the European Communities, Luxembourg. European Commission;
- EC (2002) *Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC*, Office for Official Publications of the European Communities, Luxembourg. European Commission;
- (EC, 2006) *Nature and biodiversity cases: Ruling of the European Court of Justice.* Office for Official Publications of the European Communities, Luxembourg;
- EC (2007) *Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission. European Commission;*
- DoEHLG (2009, rev 2010) *Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities.* Department of the Environment, Heritage and Local Government*;*
- DoEHLG, (2010b) Department of Environment Heritage and Local Government Circular NPWS 1/10 and PSSP 2/10 on *Appropriate Assessment under Article 6 of the Habitats Directive – Guidance for Planning Authorities*. Department of the Environment, Heritage and Local Government;
- (EC, 2013) *Interpretation Manual of European Union Habitats*. Version EUR 28. European Commission ; and
- NPWS (2013) *The Status of EU Protected Habitats and Species in Ireland*. Habitat Assessments Volume 2. Version 1.1. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Legislation

- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (also known as the 'Habitats Directive');
- Council Directive 2009/147/EC on the conservation of wild birds, codified version, (also known as the 'Birds Directive');
- The European Communities (Birds and Natural Habitats) Regulations 2011 to 2015; and

- The Planning and Development Acts 2000-2017.

The methodology comprises the following elements: Desk Study, Consultation and Field Assessments. These elements are used to identify, describe and map areas of known or potential ecological value.

A review of Ordnance Survey maps and high resolution aerial photographs of the study area was carried out prior to field visits. This exercise aimed to identify areas of low ecological value, such as; urban areas, areas under arable cultivation or under intensive pasture. The review of aerial photographs was also used to identify areas of potentially high ecological value such as woodlands and wetlands, so that field survey work was targeted to focus upon these areas. Multidisciplinary site surveys were carried out for terrestrial and aquatic flora and fauna, during the optimum seasons for the habitats and species. Specific surveys for targeted plant community groups, mammals, fish and invertebrates were conducted during the optimum seasons.

2.2 APPROPRIATE ASSESSMENT METHODOLOGY

The Department of the Environment Heritage and Local Government guidelines (DoEHLG, 2009, rev 2010) outlines the European Commission's methodological guidance (EC, 2002) promoting a four-stage process to complete the Article 6 assessments, and outlines the issues and tests at each stage. An important aspect of the process is that the outcome at each successive stage determines whether a further stage in the process is required.

The four stages are summarised diagrammatically in **Figure 1.1** and an outline of the steps and procedures involved in completing each stage follows. Stages 1-2 deal with the main requirements for assessment under Article 6(3). Stage 3 is a necessary precursor to Stage 4. Stage 4 is the main derogation step of Article 6(4). Regulations 42 and 43 of the European Communities Birds and Natural Habitats Regulations 2011 (as amended) sets out the procedures which the public authority must follow in each stage of the assessment.

In complying with the obligations under Article 6(3) and 6(4) and following the EC2000 and MN2000 Guidelines, this assessment has been structured as a stage by stage approach as outlined below.

2.2.1 Stage 1: Screening for Appropriate Assessment

Screening is the process that addresses and records the reasoning and conclusions in relation to the first two tests of Article 6(3):

- whether a plan or project (in this case the WTP and abstraction) is directly connected to or necessary for the management of the site, and
- whether a plan or project, alone or in combination with other plans and projects, is likely to have significant effects on a European site in view of its conservation objectives.

If the effects are deemed to be significant, potentially significant, or uncertain, or if the screening process becomes overly complicated, then the process must proceed to Stage 2 (AA). Screening should be undertaken without the inclusion of mitigation, unless potential impacts clearly can be avoided through the modification or redesign of the plan or project, in which case the screening process is repeated on the altered plan. The greatest level of evidence and justification will be needed in circumstances when the process ends at screening stage on grounds of no impact.

2.2.2 Stage 2: Appropriate Assessment

The aim of Stage 2 of the AA process is to identify any adverse impacts that the plan or project might have on the integrity of relevant European sites. As part of the assessment, a key consideration is 'in combination' effects with other plans or projects. Where adverse impacts are identified, mitigation measures can be proposed that would avoid, reduce or remedy any such negative impacts and the plan or project should then be amended accordingly, thereby avoiding the need to progress to Step 3.

This stage considers whether the plan or project, alone or in combination with other projects or plans, will have adverse effects on the integrity of a European site, and includes any mitigation measures necessary to avoid, reduce or offset negative effects. The proponent of the plan or project will be required to submit a Natura Impact Statement, i.e. the report of a targeted professional scientific examination of the plan or project and the relevant European sites, to identify and characterise any possible implications for the site in view of the site's conservation objectives, taking account of in-combination effects. This should provide information to enable the public authority to carry out the AA.

The information required in a Natura Impact Statement, is outlined in Regulation 42(5) (a) of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011) as amended, as follows:

(*5)(a) A Natura Impact Statement shall, in addition to addressing the issues referred to in the interpretation contained in Regulation 2(1), include such information or data as the public authority considers necessary, and specifies in a notice given under paragraph (3), to enable it to ascertain if the plan or project will affect the integrity of the site.*

(b) Where appropriate, a Natura Impact Statement shall include, in addition—

> *(i) the alternative solutions that have been considered and the reasons why they have not been adopted,*
>
> *(ii) the imperative reasons of overriding public interest that are being relied upon to indicate that the plan or project should proceed notwithstanding that it may adversely affect the integrity of a European site,*
>
> *(iii) the compensatory measures that are being proposed.*

If the assessment is negative, i.e. adverse effects on the integrity of a site cannot be excluded, then the process must proceed to Stage 3, or the plan or project should be abandoned. The competent authority must make a determination to that effect before proceeding to the next stage.

2.2.3 Stage 3: Alternative Solutions

If it is not possible during the stage 2 to reduce impacts to acceptable, non-significant levels by avoidance and/or mitigation, stage 3 of the process must be undertaken which is to objectively assess whether alternative solutions exist by which the objectives of the plan or project can be achieved. Explicitly, this means alternative solutions that do not have negative impacts on the integrity of a European site. It should also be noted that EU guidance on this step of the process states that, '*other assessment criteria, such as economic criteria, cannot be seen as overruling ecological criteria'* (EC, 2002). In other words, if alternative solutions exist that do not have negative impacts on European sites; they should be adopted regardless of economic considerations.

The process must return to Stage 2, as any alternative proposal must be subject to a Stage 2 AA before it can be subject to the Article 6(4) test. If it can be demonstrated that all reasonable alternatives have been considered and assessed, the AA progresses to Stage 4.

2.2.4 Stage 4: Imperative Reasons of Overriding Public Interest (IROPI)

This stage of the process is undertaken when it has been determined that negative impacts on the integrity of a European site will result from a plan or project, but that no alternatives exist. At this stage of the AA process, it is the characteristics of the plan or project itself that will determine whether or not the public authority can allow it to progress. This is the determination of IROPI.

In the case of European sites that include in their qualifying features 'priority' habitats or species, as defined in Annex I and II of the Directive, the demonstration of 'over-riding public interest' is not sufficient and it must be demonstrated that the plan or project is necessary for 'human health or safety considerations'. Where plans or projects meet these criteria, they can be allowed, provided adequate compensatory measures are proposed.

Stage 4 of the process defines and describes these compensatory measures. The Commission must be informed of the compensatory measures. Compensatory measures must be practical, implementable, likely to succeed, proportionate and enforceable, and they must be approved by the Minister of Housing, Planning and Local Government

2.3 STUDY AREA AND ZONE OF INFLUENCE

The study area encompasses Lough Talt, the abstraction source, the site of the proposed WTP upgrade.

Determination of the project's Zone of Influence (ZoI) was achieved by assessing the project's requirements and deliverables against the ecological receptors within the project footprint, in addition to all ecological receptors that could be connected to and subsequently impacted by the project through abiotic and biotic vectors. A 15km ZoI has been chosen as a precautionary measure, to ensure that all potentially affected European sites are included in the AA process, which is in line with *Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities* (DoEHLG, 2009, rev. 2010) and extended where required to include ecological receptors connected to the project through overlap / intersection, proximity and connectivity through features such as watercourses. The extent of the ZoI is provided in **Figure 4.1.**

2.4 DESK STUDY

The sources of published material that were consulted as part of the desk study for the purposes of the assessment are as follows:

- A review of the National Parks & Wildlife Service (NPWS) natural heritage database for designated areas of ecological interest and sites of nature conservation importance within and adjacent to the study area. Designated sites within 15km of the study area are shown in **Figure 4.1**;
- The New Atlas of British and Irish Flora (Preston *et al*., 2002) and the various British Trust for Ornithology (BTO) Bird Atlases;
- National Biodiversity Data Centre (NBDC) Database, for records of rare and protected species within the ZOI of the Lough Talt RWSS WTP upgrade;
- Literature review to identify and collate relevant published information on both ecological aspects of the study area and relevant ecological studies conducted in other areas; and
- Review of Ordnance Survey maps and of aerial images where available.

The NPWS Site Synopses for sites of nature conservation contain a description of the scientific interest and conservation importance of each designated site. The Natura 2000 Data Form contains relevant background information on each of the designated sites, while the conservation objectives summarises the aims and objectives of the designation awarded to a particular site. Where available, site specific conservation objectives supporting documents were also reviewed, such as the River Moy SAC (002298) Conservation Objectives Version 1 (NPWS, 2016) and Lough Hoe Bog SAC (000633) Conservation Objectives Version 1 (NPWS, 2017).

2.5 WALKOVER SURVEYS AND SITE VISITS

Following a full desktop study of available biological information pertaining to the study area, RPS ecologists carried out ecological assessments on the 14th March 2009, 28th and 29th August 2010, 13th January 2011, 26th January 2015 and 15th September 2015.

Molluscan surveys were carried out by Dr. Evelyn Moorkens from 2005 to 2008 on behalf of the NPWS as part of an ongoing monitoring programme, and between 2010 to 2016 on behalf of Sligo County Council and Irish Water to inform the assessment on the impacts of water abstraction from Lough Talt.

Aquatic Ecology and Fisheries Assessment was carried out by Ecofact Environmental Consultants in 2010 and 2016, to include white-clawed crayfish survey of Lough Talt and the Eighnagh River, Arctic Char, macroinvertebrates and macrophytes.

Hydrogeological monitoring and assessments have been conducted by RPS Hydrogeologists from 2014 to 2017 (ongoing).

The data collected during these surveys provided detailed information on the existing environment and is used in the identification of potential impacts of the Lough Talt RWSS WTP upgrade on terrestrial and aquatic environments.

2.5.1 Habitat Mapping

The habitats are classified in accordance with the guidelines set out in ‘A Guide to Habitats in Ireland’ (Fossitt, 2000), which classifies habitats based on the vegetation present and management history. The classification is a standard scheme for identifying, describing and classifying wildlife habitats in

Ireland. The classification is hierarchical and operates at three levels, outlining the correlation between its habitat categories and the phytosociological units (plant communities) of botanical classifications. The habitats are mapped in accordance with 'Best Practice Guidance for Habitat Survey and Mapping' (Smith et al., 2011).

In addition the Guidelines for a National Survey and Conservation Assessment of Upland Vegetation and habitats in Ireland Version 2.0 (Perrin et al., 2014) hereafter referred to as the NSUH which is vegetation classification system for upland habitats and used as a reference to aid in the assessment of habitats and correspondence with Annex I habitat classification. Habitats are also described in terms of their correspondence to Annex I habitats as per the Interpretation Manual of European Union Habitats - EUR28. The Article 17 Habitat Conservation Status Assessments (NPWS 2013) was also consulted which provides details on the conservation status, threats and pressures on listed habitats and species and also provides lists of typical species for these habitats in an Irish context.

The ecological interest of the site is assessed based on whether it is of *international, national, county or local importance* as this has a direct bearing on the potential magnitude and the significance of impacts. Seasonal factors that affect distribution patterns and habitats or species were taken into account when conducting the surveys and the potential of the site to support certain populations.

The habitats found within the study area of Lough Talt are shown in **Figure 5-1**.

2.5.2 Botanical Surveys

Common, dominant and noteworthy plant species were recorded as part of the habitat and vegetation community surveys completed in 2009, 2010 and 2015 The impact of the scheme on flora species of conservation value was also assessed.

2.5.3 Birds and Mammals

During the course of the Phase 1 Habitat Survey, the birds and mammals encountered were recorded, and any bird or mammal species of conservation concern which were found was investigated and noted. Mammal signs were actively searched for in habitats of potential importance to protected mammal species such as badgers, bats, red squirrel and others), etc. Any buildings or other structures that have potential to hold roosting bats were noted and mapped.

In addition, otter are a qualifying interest of the River Moy SAC and listed on Annex II and Annex IV of the EU Habitats Directive. Annex II species require the designation of protected areas by Member States (Special Areas of Conservation) as set out in Articles 3, 4 and 6 of the Directive. Annex IV species require strict protection measures by Member States in accordance with Article 12 of the Directive.

Otters are largely solitary, territorial and nocturnal animals and in many areas their distribution is scarce. They are rarely found far from water and tend to occupy linear home ranges along watercourses and coasts. In general, however, otters exploit a narrow strip of habitat at the aquatic – terrestrial interface (O'Neill, 2008). The extent of otter habitat in Ireland has been estimated on the basis of four classes of water bodies: rivers, streams, lakes and coast (high water mark). In addition to the aquatic habitat, a 10m riparian buffer (both banks) is considered to comprise part of the otter habitat as discussed in the Threat Response Plan for otter prepared by the National Parks and

Wildlife Service (NPWS, 2009). Otter surveys were conducted as part of the multi-disciplinary ecological surveys conducted on the 14th March 2009, 28th and 29th August 2010, 13th January 2011, 26th January 2015 and 15th September 2015. Surveys for otter holts and signs were conducted in the winter months when vegetation has died back to ensure that this seasonal constraint did not impact on the completeness of the findings of the surveys. This involved a search for all otter signs including spraints, scat, prints, slides, trails, couches and holts. This survey methodology is based on the detection of signs of otter presence or absence within a survey area and its environs and follows those methods employed in the 'Otter Survey of Ireland 2004/2005' (Bailey & Rochford, 2006) comprising a modification of the Standard Otter Survey Method developed by Jefferies (1980). Further details on the extent of otter surveys undertaken at Lough Talt and along the Eighnagh River are provided in **Section 5.3**.

2.5.4 Aquatic Ecology

Aquatic Ecology including White-clawed Crayfish and Fisheries Assessments were completed by Ecofact Environmental Consultants in 2010, 2011, 2012 and 2016 to assess the likely impacts of the proposed scheme on water quality, aquatic ecology and fisheries. The most recent assessment is included in **Appendix B**. Surveying for White-clawed Crayfish was undertaken under licence from the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs (Licence No. C139/2016). Quantitative sampling of White-clawed crayfish was undertaken at 100 potential refuges at each of the 4 survey stations along the shore of Lough Talt. The hand search method used and followed that outlined in Reynolds et al. (2010).

Other littoral macro-invertebrates were sampled at the four sites around the lake from the shore to a depth of 1 meter. The sampling methodology described in the EPA manual by Irvine et al (2001) was followed.

2.5.5 Terrestrial Invertebrates

The surveys for terrestrial invertebrates were undertaken as part of the multi-disciplinary site surveys. Specialist molluscan surveys have been undertaken by Dr Evelyn Moorkens at Lough Talt between 2005 and 2016 following survey protocol described in Killeen & Moorkens (2003) and Moorkens & Killeen (2011). *Vertigo geyeri* cannot be reliably searched for by eye in the field. To determine its presence/absence a sample of moss and sedge material (c. 2 litres volume) was collected by plucking sedge and moss from sward, mounds and tussocks, or by cutting vegetation (sward and small tussocks comprising mainly grasses, low herbs and moss) at ground level using a sharp knife with a serrated blade. This was then shaken over a 5 mm sieve to remove the bulk of the plant material but to allow all molluscs to pass through. The residue was passed over a graded stack of sieves and examined microscopically. All molluscs in the samples were identified and counted. The findings from these surveys have informed the assessment process for the Lough Talt RWSS WTP upgrade, in particular how the proposed project will impact upon the *Vertigo geyeri*, a species of qualifying interest for Lough Hoe Bog SAC. The findings of the specialist molluscan surveys completed for this project are presented in **Appendix C** and **Appendix H**.

2.5.6 Ecohydrological, Hydrological and Hydrogeological Studies

Dr. Evelyn Moorkens and RPS have undertaken hydrogeological, hydrological and ecological monitoring of Lough Talt. The Ecological surveying and monitoring accompanies the hydrological / hydrogeological surveys for Lough Talt which focus on habitat suitability for *Vertigo geyeri* (Geyer's

Whorl Snail) [1013], a species listed and protected on Annex II of the EU Habitats Directive (92/42/EC). The Assessment of *Vertigo geyeri* Habitat at Lough Talt is included in **Appendix C** and the Lough Talt Hydrogeological Impact Assessment Report is included in **Appendix D**.

Groundwater wells can be related to phreatic levels in order to understand the groundwater flow dynamics over the annual cycle as it relates to the whorl snail *V*. *geyeri*. Investigations into requirements for sustainable habitat for this sensitive snail species with regard to groundwater levels and their effect on the snail micro-habitat have been published by Kuczyńska & Moorkens (2010)[2]. To this end, measurements of micro-topography, monitoring of hydro-micrological parameters on suitable fen habitat fringing Lough Talt in addition to the assessment of *V*. *geyeri* habitat were undertaken. Following the installation of the loggers, the micro-topographical measurements, and the initial assessment of *V*. *geyeri* micro-habitat, two monitoring rounds were co-ordinated in March and September 2016 with proposed hydrogeological monitoring. In each round the micro-habitat was classified, and snail sampling was undertaken. The methodology and subsequent findings of the micro-topographical and microhabitat surveys at Lough Talt are presented in full in **Appendix C**.

[2] Kuczyńska, A. & Moorkens, E.A. (2010). Micro-hydrological and micro-meteorological controls on survival and population growth of the whorl snail *Vertigo geyeri* Lindholm, 1925 in groundwater fed wetlands. *Biological Conservation* **143,** 1868–1875.

3 PROJECT DESCRIPTION

3.1 EXISTING SCHEME

The Lough Talt RWSS provides a supply of treated drinking water to an estimated population of 13,663 through a 520km long pipe distribution network. It is a primarily rural scheme serving the area south and east of the Ox Mountains, between Bellaghy in the south, Collooney in the north, the Sligo/Mayo county boundary in the west and Gurteen and Ballymote in the east. The main towns and villages served by the scheme include; Annagh, Aclare, Curry, Tubbercurry, Lavagh, Ballinacarrow, Carroweden, Kilmacteige, Coolaney, Bellaghy and Ballymote.

There is an existing WTP located in Gortersluin townland. This plant was constructed in 1972 and consists of:

- A control building which houses a microstrainer unit (designed to treat 5.5 MLD). This unit is currently bypassed;
- The main building which houses chlorine and soda ash dosing equipment, store rooms, a kitchen, toilet and office; and
- A treated water holding tank with a capacity of 307m^3.

Image 3.1: Existing Water Treatment Plant

The existing water treatment provision at Lough Talt has significant water quality deficiencies including:

- Inadequate water treatment, resulting in high levels of THMs in the treated water; and
- No cryptosporidium barrier with a subsequent very high risk of cryptosporidium entering the drinking water supply. A boil water notice is currently in place.

The Drinking Water Directive (98/83/EC) and related national regulations, set out the quality and monitoring requirements for potable water supplies. The EU Drinking Water Directive is transposed into Irish law by the European Communities (Drinking Water) Regulations 2014 (the "Drinking Water Regulations"). These Regulations prescribe the quality standards that apply and related supervision and enforcement procedures that apply to supplies of drinking water.

Under the Drinking Water Regulations, Irish Water, as the water services authority, must:

- Ensure any water it provides is wholesome and clean and meets prescribed quality standards;
- Measure compliance in accordance with a prescribed sampling and analysis regime;
- Monitor the compliance of all drinking water supplies; and
- Take appropriate remedial action (or ensure that action is taken) to restore the quality of non-compliant supplies.

The current basic water treatment facilities consist of chlorination and fluoridation, which do not address the water quality deficiencies present and is inadequate to provide drinking water which is in compliance with the Drinking Water Regulations.

The Lough Talt water supply scheme has drinking water regulation non-compliance issues with regard to THM exceedances and the current level of treatment provides no barrier against cryptosporidium. 140 water samples taken from the supply have been non-compliant with the drinking water regulations over the past 14 years (2004-2018).

The Lough Talt RWSS is on the EPA's Remedial Action List (RAL) due to "Inadequate treatment for Cryptosporidium". The EPA issued a Direction to Irish Water on the 15th August 2014 in relation to inadequate disinfection. On the 3rd December 2014 a further Direction was issued by the EPA in relation to exceedances in THM. Directions issued under Regulation 10(4) refer to failures to meet a quality standard or indicator parameter. Under the legislation, the agreed action plan must be implemented, within one year of the approval date where there is a risk to human health or two years where a risk to human health does not exist.

Furthermore, the European Commission advised the Irish government that it is monitoring the remedial measures being taken in relation to water supplies where there are THM exceedances (EU Pilot 7544/2015/ENVI). THM risk is also a precautionary public health issue, though its impact is thought to be associated with long term exposure rather than immediate impact.

The current level of treatment provides no barrier against cryptosporidium. A Boil Water Notice was put in place on Monday 5th February for the Lough Talt RWSS following the detection of cryptosporidium in the treated water coming from the plant after a routine test.

Both the cryptosporidium and the exceedances in THMs issues are important public health risks, with cryptosporidium giving rise to severe gastroenteritis in patients affected and in extreme situations can endanger vulnerable people, where their health is poor in any case. THMs meanwhile are classified as 'possibly carcinogenic' to humans. Irish Water has committed to addressing these public health risks in its drinking water supplies as its top priority.

3.2 PROPOSED WATER TREATMENT PLANT UPGRADE

3.2.1 WTP Upgrade Location

It is proposed to construct the WTP upgrade within and adjacent to the existing WTP site. The site is located in the Gortersluin townland adjacent to the R294 Regional Road as shown in **Figure 3.1**. The existing WTP site will be expanded as necessary to include for the new treatment process.

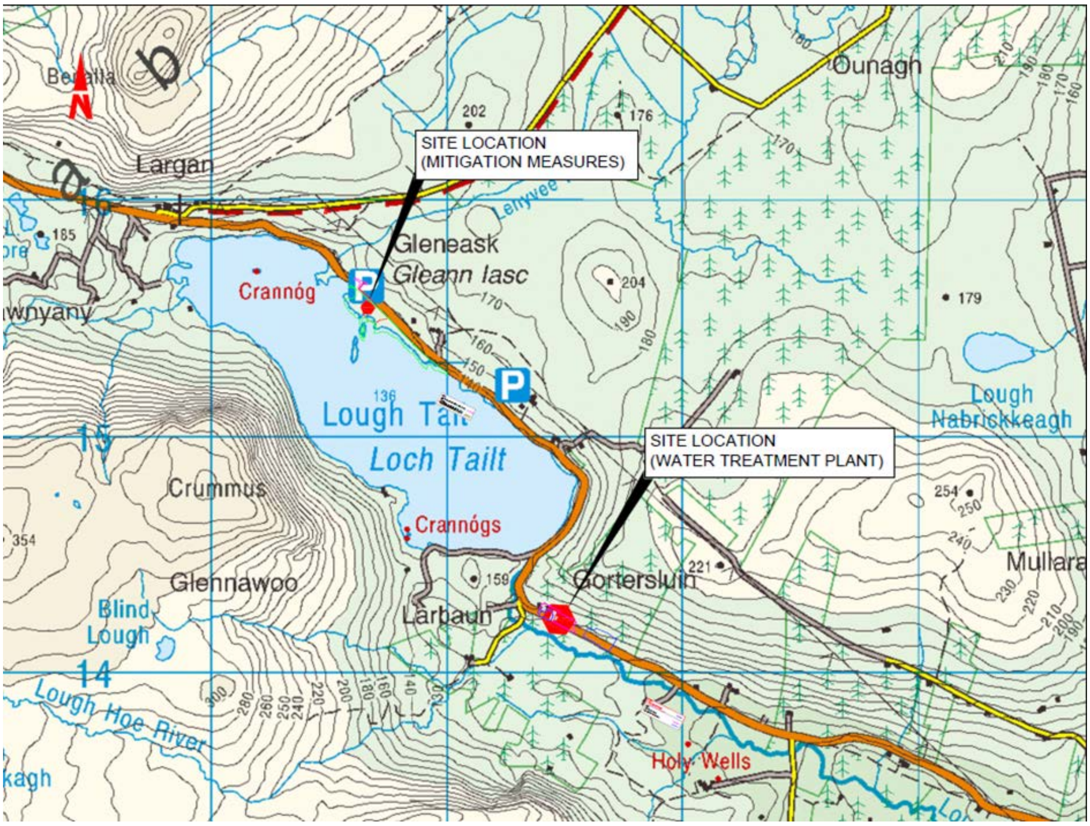


Figure 3-1: Location of Lough Talt WTP

This area supports the existing built infrastructure of Lough Talt RWSS WTP which includes operations buildings, holding tanks, boundary walls and some built ground to facilitate vehicular access. The fringes of the WTP site support amenity grassland, in addition to areas of unmanaged grassland that support a mosaic of dry meadows and grassy verge and wet grassland habitat. The proposed WTP site is set within an area dominated by recently felled Coillte conifer plantation and mature conifer plantation to the south. The WTP is situated on relatively steep sloping ground, located on the higher reaches of the Eighnagh river valley located less than 100m south. The footprint of the proposed WTP supports drainage channels that form connectivity to the Eighnagh River. The Eighnagh River is designated under the River Moy SAC (Site Code 002298).

The site will be accessed via a shared access with an existing Coillte entrance off the R294 regional road and will occupy a site area of 0.85 hectares and will necessitate the acquisition of additional lands from Coillte adjacent to the existing WTP site. Coillte has confirmed that the existing access is used infrequently and it is not expected that the construction or ongoing operation of the Water Treatment will have a significant impact on Coillte operations. The upgrade works on the existing access road will be coordinated with Coillte to ensure that any required access is maintained during the works.

The raw water supply for the WTP is from Lough Talt which is designated as part of the Lough Hoe Bog (SAC). Lough Hoe Bog SAC is designated for the Annex I habitats including [3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*), [7130] Blanket bogs (*if active only), [1013] Vertigo's whorl snail (*Vertigo geyeri*) and [1092] White clawed crayfish (*Austropotamobius pallipes*).

3.2.2 Site Location of Hydrological Mitigation Measures

Hydrological and hydrogeological mitigation measures are proposed to mitigate for potential adverse effects to the rich fen habitat on the north-eastern shores of Lough Talt which provides suitability for *V*ertigo *geyeri,* a qualifying interest of Lough Hoe Bog SAC. The site is located in the Gortersluin townland adjacent to the R294 Regional Road as shown in **Figure 3.1**. The fen habitat is not fenced and not actively managed by grazing. Some tracks within the habitat may be from boat trailers and quad bikes accessing the area and this has led to some damage.

3.2.3 Nature and Extent of Proposed Works

3.2.3.1 Raw Water Abstraction

The Lough Talt RWSS has been continuously abstracting water from Lough Talt since the 1950s. During the late 1990s the abstraction reached a peak of 10.5 MLD, however due to significant water conservation investment, the average abstraction is now approximately 8 MLD (average daily abstraction for the period 2014-2017 was 7,800 m^3). No works are proposed to the lake intake pipeline.

3.2.4 Proposed Water treatment Plant Upgrade

The proposed development will include the upgrade of the existing WTP with a treated water production capacity of 8 MLD, matching the current abstraction levels. The upgraded plant will treat the Lough Talt raw water to the required quality standards to ensure that water supplied to the Lough Talt RWSS, will meet standards set out in the Drinking Water Regulations, and risks to public health will be minimised. All backwash water (water refluxed from the filtration process) will be recycled within the water treatment process. Therefore, there is very little 'lost' water from the process as it is reused. The only waste from the water treatment process will settled solids (from the backwash water) which will be taken off-site on a regular basis via a tanker truck. The settled solids will be taken to an Irish Water Waste Water Treatment Plant (WWTP) in the area for dewatering and ultimately for reuse elsewhere or for disposal to landfill.

The attached drawings (**Appendix A**) indicate the proposed treatment process.

The principal elements of the WTP upgrade include the construction of the elements described below.

Treatment Elements to address the public health risks include the following:

- Treatment Process units e.g. pressure filters, ultraviolet treatment and disinfection;
- Temporary containers to house the process units, controls, chemical storage and dosing, including:
  - 4 containers (12.2m L x 2.4m W x 2.6m H) to house the pressure filters
  - 2 containers (6 m x L x 2.4 m W x 2.6m H) to house UV disinfection units
  - Kiosks to house controls and pumping equipment
- New Chlorine Contact Tank (12m diameter x 4m high)
- Used wash water equalisation and settling tanks;
- Solids settling and storage tanks;
- Various smaller underground chambers, for example; flow measurement chambers.

Ancillary Items to facilitate the Treatment plant works include the following:

- New access onto the R294 and internal access roads, footpaths and parking areas. The existing entrance will be closed off upon completion of the works;
- Site works including cut and fill to facilitate the installation of tanks and roadways;
- Site fencing;
- Site drainage, ducting and internal pipework (no works are proposed to the intake pipe or external network pipelines as part of these works);
- Landscaping to include indigenous screening planting, mounding, retaining walls and general site landscaping;
- Attenuation of storm water to reduce run off to Greenfield rates; and
- Irrigation system at fen habitat as part of the proposed Mitigation Measures in the NIS.

Proposed Mitigation measures include the following:

- Irrigation system at fen habitat as detailed in **Section 5.5.3.1**.

There will be no process outputs emanating from the proposed WTP upgrade. Chemicals and hydrocarbons associated with the water treatment process will be stored in bunded and contained areas (with 110% capacity) of the WTP.

The use of containerised units and precast concrete tanks will facilitate the removal of these structures when they are no longer required.

The proposed design of the WTP upgrade is presented in **Drawing Number MGW0214DG0016 in Appendix A**.

3.2.4.1 Wastewater

There will be no process wastewater discharge as a result of the proposed water treatment works. All backwash waters will be recirculated to the head of the plant for treatment. Settled Solids from the backwash process will be stored in tanks prior to being taken off-site via a tanker truck. The settled solids will be taken to an Irish WWTP in the area for dewatering and ultimately for reuse elsewhere or for disposal at a licensed facility.

Surface water will be collected, attenuated and discharged via a Class 1 by-pass hydrocarbon interceptor to the existing drainage channels on-site which ultimately discharge to the Eighnagh River. The hydrocarbon interceptor will be provided with an alarm system to alert the WTP operator when 90% full and will be emptied to a suitable licenced waste facility. In addition, routine maintenance will be completed for the hydrocarbon interceptor in accordance with manufacturer's instructions.

Chemicals will be stored on the site both inside the building and outside. Chemical tanks will be provided with 110% bunded volume. Chemicals used as part of the water treatment process will include Sodium Hypochlorite and Liquid Ammonium Sulphate for Disinfection and Hydrofluorosilicic Acid for fluoridation purposes.

3.2.5 Proposed Hydrological Mitigation Measures

The hydrological mitigation measures will implement a combination of surface irrigation and monitoring to provide suitable habitat for *Vertigo geyeri* to establish.

It is proposed that the surface irrigation system would comprise the following:

- **Submersible Pump:** A submersible pump will be installed in the existing boreholes within the site BH2D and/or BH3D.
- **Power Supply**: A power supply will be required for the submersible pump. This will include connection to the existing overhead power supply and a small kiosk. A new ESB pole may be required but this would be located outside the SAC. The kiosk maybe located within the SAC along with cabling and ductwork will not have an impact on the qualifying interests of the SAC.
- **Pump Headworks**: Comprising a stop valve, butterfly valve, pressure gauge, and flow meter.
- **Pipe Network & Discharge Mechanism.**

The exact make-up of the surface irrigation system will be confirmed at the start of the process while on-site. All site works will be undertaken under the supervision of an ecologist.

It is not proposed to fence the site of the mitigation measures as the site is not actively grazed and access to the site will be maintained via the existing track. Full details on the proposed hydrological mitigation measures are provided in **Section 5.5.3.1.**

3.2.5.1 Decommissioning

Irish Water is applying to Sligo County Council for planning permission to upgrade the existing WTP and continue to use the upgraded WTP for a period of 10 years, after which time the WTP will be decommissioned and the abstraction of raw water from the lake will cease once the replacement source is in place.

The cessation of the abstraction of 8,000m^3/day from Lough Talt will potentially increase the levels in the lake as well as the discharge from the lake to the Eighnagh River. The outflow to the Eighnagh River is proportional to the lake level so the cessation of the abstraction will initially lead to a slight increase in lake levels but ultimately will lead to increased outflows from the lake. The Eighnagh River has a 5%ile flow of 1.667 m^3/sec at a point approximately 500m downstream of the lake outfall. This corresponds to the flowrate that is exceeded 5% of the time. The increased discharge from the lake will increase this flow by 0.0925 m^3/sec or approximately 5.5%. For higher flow events and at points further downstream the effect will be even less. There is no history of flooding along this section of the river (www.floodmaps.ie) and as such the small increase in river flows is not expected to lead to any increase in flooding downstream. There are three locations in the vicinity of the lake with flooding history but these were identified as occurring during heavy rain as a result of runoff coming off high ground and not from the lake itself. During periods of low flow the cessation of the abstraction will increase the flow rate in the river. The 95% flow in the river at the same location (i.e. approx. 500m downstream of the lake outfall) is 0.037 m^3/sec. The cessation of the abstraction will increase the flow in the river by up to 250% during these conditions.

4 SCREENING FOR APPROPRIATE ASSESSMENT

A screening for AA was conducted to examine the likely significant effects of the proposal, individually or in combination with other plans or projects, on European sites in light of their conservation objectives. The screening exercise identified European sites that were situated within a 15km zone of the development, as described in **Section 2.3,** in addition to sites supporting connectivity, both direct and indirect, with the proposed project.

4.1 EUROPEAN SITES WITHIN THE ZOI OF THE PROPOSED DEVELOPMENT

Table 4.1 lists the European sites within the ZoI of the project area, outlining their proximity and connectivity to the proposed WTP upgrade. **Figure 4-1** outlines the location of these European sites within a ZoI of the Lough Talt RWSS WTP upgrade. **Figure 4-2** shows the location of these European sites in proximity to the proposed treatment plant.

4.1.1 Connectivity

There are five European sites within the ZoI of the Lough Talt RWSS WTP upgrade (See **Table 4.1** and **Figure 4-1**).

The Ox Mountains SAC, Lough Nabrickkeagh Bog SAC and Turloughmore SAC are not connected to RWSS via surface water courses or environmental vectors such as air and noise. These European sites are located within the same groundwater catchment as the Lough Talt RWSS WTP upgrade; i.e. Foxford Groundwater catchment (See **Section 5.1.6**). However, the Foxford Groundwater Body is characterised by low transmissivities[3] of 0.1-10 m^2/d meaning that there is very poor hydrogeological connectivity (and potential to serve as a pathway / conduit for significant negative effects) between the proposed development site and each of these European Sites. Therefore potential impacts emanating to groundwater as a result of the Lough Talt RWSS WTP upgrade will be localised due to the low transmissivities of the underlying groundwater catchment. Therefore, the Ox Mountains SAC, Lough Nabrickkeagh Bog SAC and Turloughmore SAC European sites do not support connectivity with the Lough Talt RWSS.

The proposed project supports direct connectivity with Lough Hoe Bog SAC through the proposed abstraction, direct connectivity with the River Moy SAC through Eighnagh River which is the only outflow from Lough Talt, and a tributary of the River Moy. Indirect connectivity with the River Moy SAC is provided via the sites drainage channels and potential overland flow. Therefore both of these European Sites are within the ZoI of the proposed works.

[3] Rate through which water flows or passes horizontally through an aquifer. It is a parameter which characterises rocks as water conducting strata.

Table 4.1: European sites within the 15km buffer zone of the Lough Talt RWSS WTP upgrade

Site Code	Site Name	Qualifying Habitats	Qualifying Species	Distance from the Lough Talt upgrade	Connectivity
000633	Lough Hoe Bog SAC	(3110) Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) (7130) Blanket bogs (*if active only)	(1013) Vertigo's whorl snail (*Vertigo geyeri*) (1092) White clawed crayfish (*Austropotamobius pallipes*)	Abstraction at Lough Talt within European site and WTP 310m south east	Yes – Abstraction from Lough Talt may affect the structure and function of Lough Hoe Bog SAC through impacts to surface water and groundwater dependent habitats and species. The cessation of abstraction during the decommissioning stage is not likely to have a significant effect on the conservation objectives of the SAC.
002298	River Moy SAC	(7110) *Active raised bogs (7120) Degraded raised bogs still capable of natural regeneration (7150) Depressions on peat substrates of the Rhynchosporion (7230) Alkaline fens (91A0) Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles (91E0) *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)	(1092) White clawed crayfish (*Austropotamobius pallipes*) (1095) Sea lamprey (*Petromyzon marinus*) (1096) Brook lamprey (*Lampetra planeri*) (1106) Atlantic salmon (*Salmo salar*) (only in fresh water) (1355) Otter (*Lutra lutra*)	50m south of WTP	Yes – There are potential impacts between the proposed WTP upgrade and the Eighnagh River via surface water run-off to site's drainage channels (and run-off via overland flow) during the project construction phase. The Eighnagh River is designated as part of the River Moy SAC. The drying out of this river for a period during the year may be exacerbated by abstraction and may impact the qualifying interests of the River Moy SAC. The cessation of abstraction during the decommissioning stage is not likely to have a significant effect on the conservation objectives of the SAC.
000634	Lough Nabrickkeagh Bog SAC	(7130) Blanket bogs (*if active only)	n/a	590m north-east of Lough Talt WTP and 170m north-east of Lough Talt at its closed point	No - Nabrickkeagh Bog SAC is outside the hydrological influence of Lough Talt, it is however located within the same groundwater catchment (Foxford Groundwater Body). However, the groundwater body is characterised by low transmissivities and potential impacts to groundwater as a result of the Lough Talt RWSS WTP upgrade are likely to be local at

Site Code	Site Name	Qualifying Habitats	Qualifying Species	Distance from the Lough Talt upgrade	Connectivity
					worst and outside of the zone of influence for Lough Nabrickkeagh SAC. Furthermore, this European site is designated for blanket bog, an ombrotrophic (rain fed) habitat that is located up gradient from Lough Talt. Therefore, the proposed Lough Talt RWSS WTP upgrade will not impact upon the hydrological or hydrogeological integrity of this European site.
002006	Ox Mountains SAC	(3110) Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) (3160) Natural dystrophic lakes and ponds (4010) Northern Atlantic wet heaths with *Erica tetralix* (4030) European dry heaths (7130) Blanket bogs (*if active only) (7140) Transition mires and quaking bogs (7150) Depressions on peat substrates of the Rhynchosporion	(1013) Vertigo's whorl snail (*Vertigo geyeri*) (1528) Marsh saxifrage (*Saxifraga hirculus*)	3.5km north-west at its nearest point	No - Ox Mountains SAC is located within the same groundwater catchment (Foxford Groundwater Body), however the groundwater body is characterised by low transmissivities and potential impacts to groundwater as a result of the Lough Talt RWSS WTP upgrade are likely to be local at worst and outside of the zone of influence for the Ox Mountains SAC. In addition, the low transmissivity of the Foxford Groundwater body means that it does not serve as a pathway for significant effects to this European Site.
000637	Turloughmore (Sligo) SAC	(3180) *Turloughs	n/a	13km east	No – Turloughmore (Sligo) SAC is underlain by a regionally important aquifer. However no abstraction from groundwater is proposed, therefore there will be no impact to this European site.

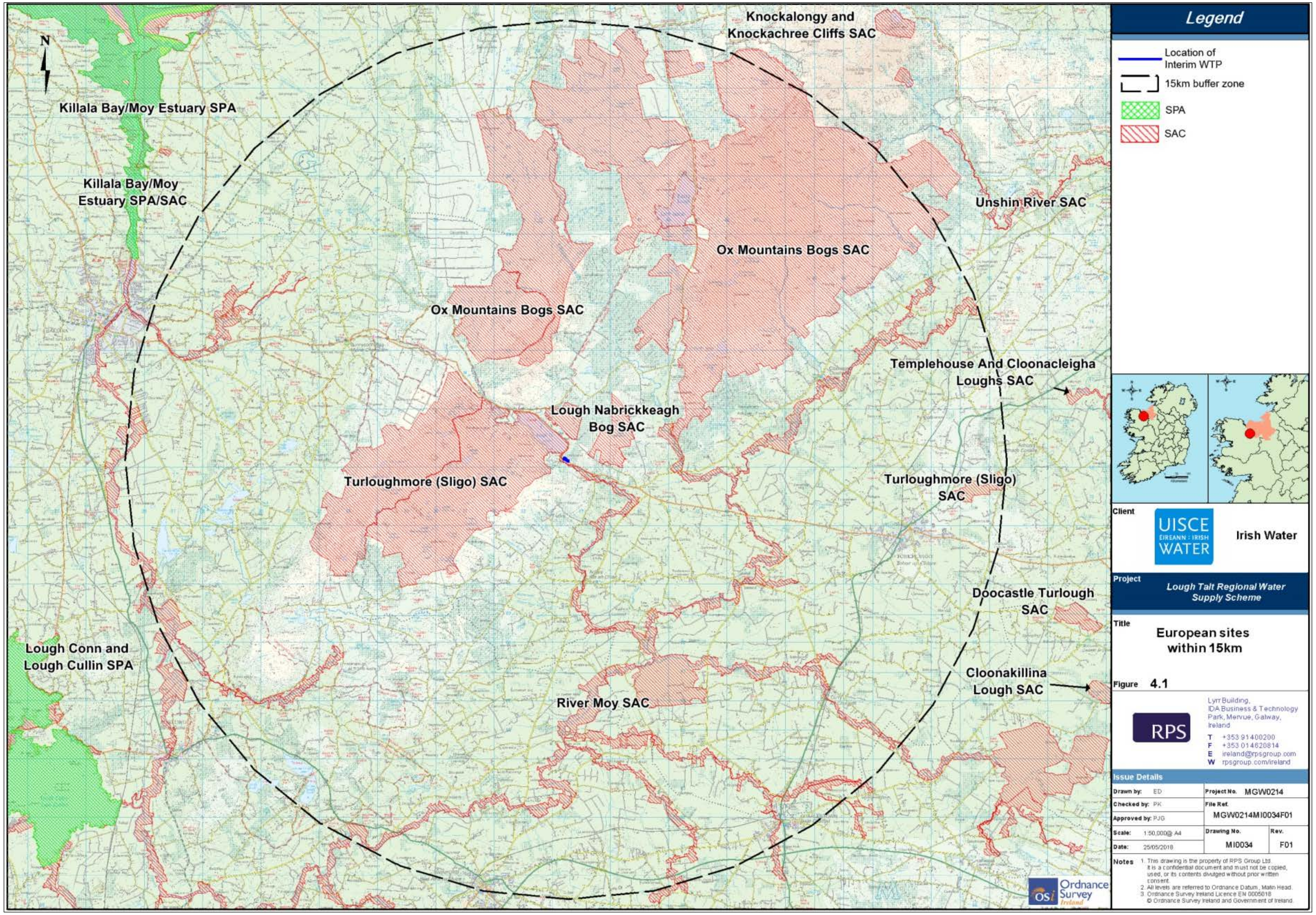


Figure 4-1: European Sites within 15km of Lough Talt WTP upgrade

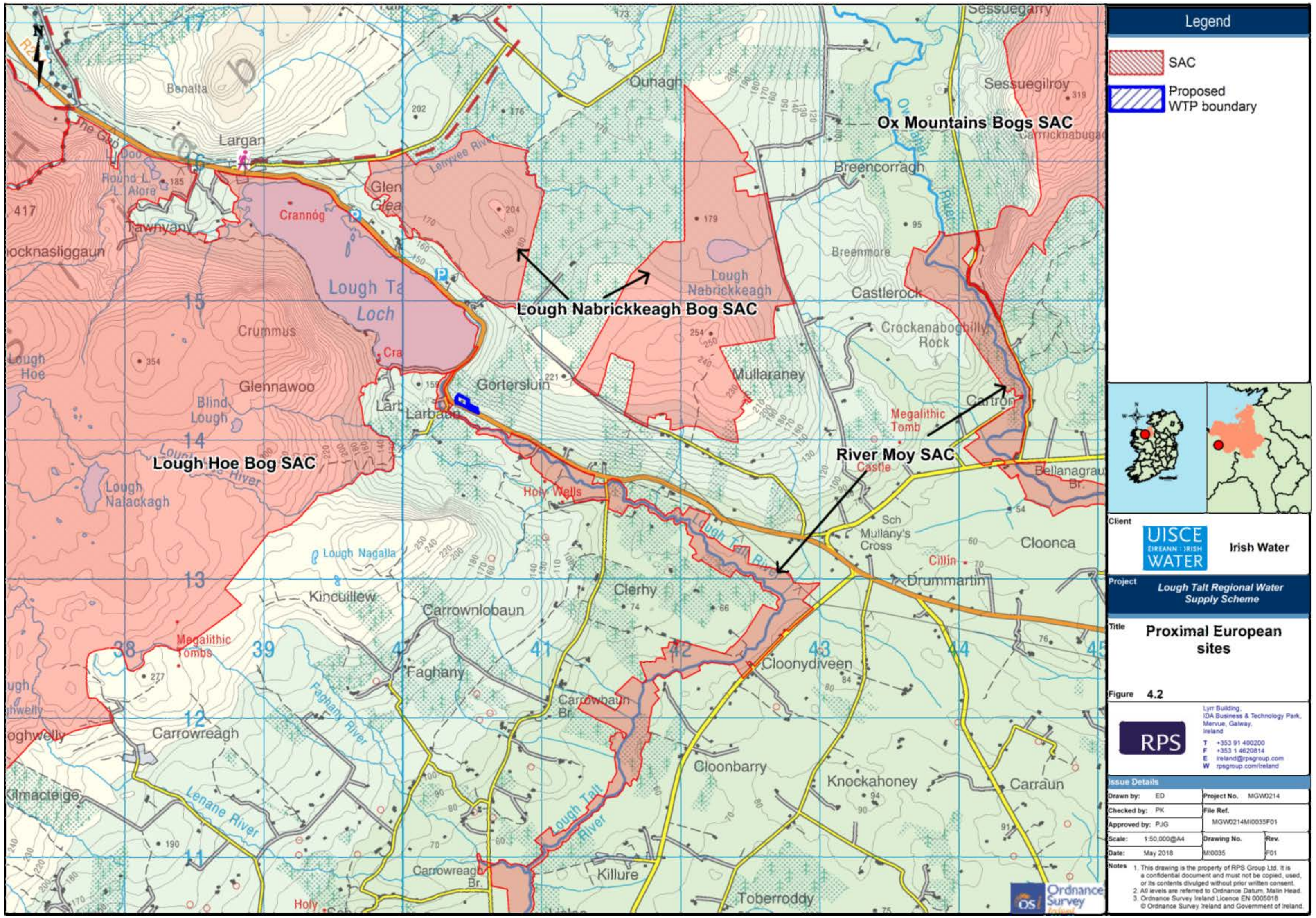


Figure 4-2: European Sites in proximity to the Lough Talt WTP upgrade

4.2 STAGE 1 - SCREENING FOR APPROPRIATE ASSESSMENT MATRIX

This section provides a Screening for AA for the proposed Lough Talt RWSS WTP upgrade project. **Table 4.2** provides a matrix assessing potential impacts, direct and indirect, to European sites within the project ZoI. Each assessment criterion follows the European Commission's methodological guidance (EC, 2002).

Table 4.2: Screening for Appropriate Assessment

<table>
<tr><th>Appropriate Assessment Screening Criteria</th><th>Response</th></tr>
<tr><td>Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Sites</td><td>SI Works and Construction

There is potential for pollutants associated with the project’s SI works and construction to enter channels draining the proposed WTP upgrade continuing south to the Eighnagh River. The Eighnagh River is designated as part of the River Moy SAC.

The individual elements associated with the proposed WTPs site investigation works, and construction likely to result in impacts to proximal and connected European sites are as follows:
▪ Generation of silt laden waters and potential SI works / construction phase pollutants; e.g. silted waters, hydrocarbons, cement, bituminous materials etc. carrying such potential pollutants to the site’s drainage channels (which support connectivity with the Eighnagh River);
▪ Excavation and importing of construction material during the SI works and the project’s construction phase; and
▪ Transport of construction waste arising on site will be transported to a licenced waste facility.

Operational Phase

There will be no discharge of treated water or wastewater from the proposed WTP upgrade. All backwash waters will be recirculated to the head of the plant for treatment. Surface water will be collected, attenuated and discharged via a hydrocarbon interceptor to the existing drainage channels on-site which ultimately discharge to the Lough Talt River. Sludge generated during the water treatment process will be thickened within the bounds of the WTP and dewatered off-site at a nearby WWTP. The dewatered sludge will ultimately be reused off-site or disposed of at a licenced waste facility. The operation of the proposed WTP upgrade will result in the ongoing abstraction of water from Lough Talt.

Potential impacts associated with the abstraction associated with proposed WTP upgrade at Lough Talt include drawdown of water levels within the Lough Talt waterbody and consequent impacts to surface and groundwater dependent features of qualifying interest associated with the in-situ European Site, Lough Hoe Bog SAC and the River Moy SAC.

Decommissioning

Irish Water is applying to Sligo County Council for planning permission to upgrade the existing WTP and continue to use the upgraded WTP for a period of 10 years, after which time the WTP will be decommissioned and the abstraction of 8MLD of raw water from the lake will cease once the replacement source is in place.
▪ Decommissioning of the proposed WTP upgrade may result in the release of deleterious material such as hydrocarbons, silted water, chemicals associated with the water treatment process etc.; and
▪ The cessation of the abstraction of 8MLD from Lough Talt will potentially increase the levels in the lake as well as the discharge from the lake to the Eighnagh River. The outflow to the river is proportional to the lake level so the cessation of the abstraction will initially lead to a slight increase in lake levels but ultimately will lead to increased</td></tr>
</table>

Appropriate Assessment Screening Criteria	Response
	outflows from the lake. Therefore, the cessation of abstraction of raw water from Lough Talt is not likely to have a significant effect on the conservation objectives of the Lough Hoe Bog SAC and the River Moy SAC.
Describe any likely direct, indirect or secondary impacts of the project on the European Sites	***SI Works and Construction*** The proposed WTP upgrade is not located within the bounds of a European Site; therefore there is no potential for direct impacts. The site supports connectivity to the Eighnagh River which is designated as part of the River Moy SAC. Given this connectivity, there is scope for indirect impacts to this European site, principally associated with the SI works and during the project's construction phase where potential pollutants can be released to surrounding watercourses and channels. Drainage and inflow of pollutants as a result of the construction works are of primary conservation concern as part of the scheme and the associated environs. Deterioration of water quality within the site's drainage channel could lead to indirect impacts to the Lough Talt River which is designated as part of the River Moy SAC. ***Operation*** There will be no discharge of treated water or wastewater from the proposed WTP upgrade. All backwash waters will be recirculated to the head of the plant for treatment. Surface water will be collected, attenuated and discharged via a hydrocarbon interceptor to the existing drainage channels on-site which ultimately discharge to the Lough Talt River. Sludge generated during the water treatment process will be thickened within the bounds of the WTP and dewatered off-site at a nearby WWTP. The dewatered sludge will ultimately be reused off-site or disposed of at a licenced waste facility. The operation of the proposed WTP upgrade will result in the ongoing abstraction of water from Lough Talt be located to within the bounds of the WTP in bunded, secure holding areas. However, the proposed abstraction is located within Lough Talt, which is designated as part of Lough Hoe Bog SAC. Ongoing and continued abstraction may result in the continued drawdown of water levels within the Lough Talt waterbody. This in turn may result in consequent impacts to surface and groundwater dependent qualifying features of the in-situ European Site, Lough Hoe Bog SAC and the River Moy SAC. ***Decommissioning*** The cessation of the abstraction of 8MLD from Lough Talt will potentially increase the levels in the lake as well as the discharge from the lake to the Eighnagh River. The outflow to the river is proportional to the lake level so the cessation of the abstraction will initially lead to a slight increase in lake levels but ultimately will lead to increased outflows from the lake. Therefore, the cessation of abstraction of raw water from Lough Talt is not likely to have a significant effect on the conservation objectives of the Lough Hoe Bog SAC and the River Moy SAC.
Size and Scale	The areas of the River Moy SAC and Lough Hoe Bog SAC are large when compared to the area of the proposed project. However elements of the project's operational phase could result in reductions in the size and scale of ground and surface water dependent habitats and species of qualifying interest associated with Lough Hoe Bog SAC and the River Moy SAC.

Appropriate Assessment Screening Criteria	Response
Land Take	There will be no land-take of European sites within the project zone of influence.
Distance from European sites or key features of the site	The proposed WTP upgrade is located within 50m of the Eighnagh River which is designated as part of River Moy SAC. During the SI and construction works, there will be potential for temporary run-off from the development site to the Lough Talt River via the sites drainage channels (part of the River Moy SAC). Raw water will be abstracted from Lough Talt during the project operational phase. Lough Talt is designated as part of Lough Hoe Bog SAC.
Resource Requirements	The proposed works will require the importation of material for construction including aggregate (clay, sand and gravel) for the WTP upgrade and surrounds, tarmac and concrete pouring equipment, steel and timber. Fuel will be consumed by construction equipment while water will be required for various construction practices. The operation of the proposed WTP upgrade has a treatment capacity of 8,000 m3 / day. There will be no requirement for water or any other resources to be taken from natural resources during the SI works or the construction of the WTP upgrade. During the project's operational phase, water will be abstracted from Lough Talt (designated as Lough Hoe Bog SAC) for treatment at the proposed WTP upgrade. Abstraction rates proposed as part of the Water Treatment Plant will correspond to current abstraction rates at Lough Talt; i.e. 8,000m^3. Potential impacts associated with the abstraction associated with proposed WTP upgrade at Lough Talt include drawdown of water levels within the Lough Talt waterbody and consequent impacts to surface and groundwater dependent features of qualifying interest associated with the in-situ European Site, Lough Hoe Bog SAC and the River Moy SAC.
Emissions	***SI Works and Construction*** There is potential for emissions associated with the SI works and the project's construction phase affecting two main sources; i.e. water and air. Emissions emanating to water could include fine sediment, silt, and hydrocarbons from plant machinery associated with SI works and the project's construction phase. Emissions to air will include fine particulate matter associated with ongoing excavations and other construction practices. As stated in earlier sections, such emissions have the potential to impact negatively on the qualifying features of the European sites (specifically the aquatic environment). ***Operation*** There will be no aqueous emissions or by-product output during the proposed WTPs operational phase and thus no potential for impact in this regard. All aqueous materials will be recirculated back into the water treatment process. Sludge generated during the water treatment process will be thickened and hardened within the bounds of the WTP. Once sufficiently thickened and hardened, sludge will be collected and disposed off-site to a licenced waste facility. ***Decommissioning*** Decommissioning of the WTP may result in the release of deleterious material such as silt from decommissioning works, hydrocarbons, silted water, chemicals associated with the water treatment process etc.

Appropriate Assessment Screening Criteria	Response
Excavation Requirements	***SI Works and Construction*** There will be a requirement to excavate parent material as part of the SI works and during the construction phase of the proposed WTP upgrade. In the absence of best practice, such excavation requirements could impact proximal and adjoining watercourses through the continued and sustained release of sediment and particulate matter that in turn could impact the River Moy SAC located downstream. Excavation volumes and parent materials associated with the projects construction phase will be informed by the SI works. ***Operation*** There will be no excavation requirements associated with the projects operational phase and thus no potential for associated impacts. ***Decommissioning*** The decommissioning of the WTP may result in the release of deleterious material such as silt from decommissioning works.
Transport Requirements	***SI Works and Construction*** As part of the SI Works and the project's construction, sustained and ongoing transport of personnel and raw materials will be required within the land-take and immediate surrounds of the proposed WTP upgrade site. In addition, haulage of raw materials and aggregate material will be required throughout the projects construction phase. This will also involve transport of material and personnel to and from the site. In the absence of best practice and construction design, ongoing and sustained transport during the construction phase could influence particulate matter levels in receiving watercourses draining the site that in turn could impact the River Moy SAC located downstream. ***Operation*** Transport requirements during the project's operational phase will involve routine visits by site operation and maintenance staff. ***Decommissioning*** Transport requirements during the projects decommissioning phase will be minimal.
Duration of construction, operation and decommissioning	***SI Works and Construction*** The proposed WTP upgrade will be constructed over a time period of approximately 9 months and any resulting significant effects will be temporary in nature and restricted to the footprint of the proposed development site. Timing of works during periods of seasonally low flows; i.e. May to October, will limit the risk of water based pollutants being released from the site, especially following sustained rainfall events. ***Operation*** The proposed operational phase will be short to medium term (7-10 years) in nature. However, the continued abstraction during this timeframe may continue to affect the structure and function of Lough Hoe Bog SAC through impacts to surface

Appropriate Assessment Screening Criteria	Response
	water and groundwater dependent habitats and species. In addition, the drying out of a 300m stretch of the Eighnagh River downstream of the Lough Talt may affect the surface water dependent species of the River Moy SAC. ***Decommissioning*** The cessation of the abstraction of 8MLD from Lough Talt will potentially increase the levels in the lake as well as the discharge from the lake to the Eighnagh River. The outflow to the river is proportional to the lake level so the cessation of the abstraction will initially lead to a slight increase in lake levels but ultimately will lead to increased outflows from the lake. Therefore the cessation of abstraction of raw water from Lough Talt is not likely to have a significant effect on the conservation objectives of the Lough Hoe Bog SAC and the River Moy SAC.

4.2.1.1 Cumulative Impacts with Other Plans and Projects in the Area

This assessment aims to identify any possible significant in-combination or cumulative effects/impacts of the Lough Talt RWSS WTP upgrade with other plans and projects on European sites.

Incremental habitat loss, species loss and disturbance are potential effects arising from the Lough Talt RWSS WTP upgrade, whereby a series of individually modest impacts may in combination produce a significant impact. This assessment provides an integrated mechanism to assess the cumulative impacts of arising from the development, in-combination with other plans and projects potentially affecting change within Lough Hoe Bog SAC and the River Moy SAC.

An assessment on the Potential In-Combination Effects of Other Plans and Projects is presented in **Table 4.3**.

Table 4.3: Potential In-Combination Effects of Other Plans and Projects

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
	LAND USE AND SPATIAL PLANS	
Sligo Development Plan 2017-2023	**Aquaculture, mariculture and fishing - Policy** • **P-AMF-1** Facilitate sustainable fishing, aquaculture and mariculture development associated with job creation, in a manner that is compatible with other uses of the Sligo coast, and subject to compliance with the requirements of the Habitats Directive, Water Framework Directive, the provisions of the EC (Quality of Shellfish Waters) Regulations and objectives of Shellfish Pollution Reduction Programmes. **Heritage – General Objectives** • **O-H-2** Adopt and implement, in partnership with all relevant stakeholders, the *County Sligo Biodiversity Action Plan 2011-2015* and subsequent biodiversity plans. **Natural Heritage – General Policies** • **P-NH-1** Protect, sustainably manage and enhance the natural heritage, biodiversity, geological heritage, landscape and environment of County Sligo in recognition of its importance for nature conservation and biodiversity, and as a non-renewable resource, in association with all stakeholders. • **P-NH-2** Promote increased understanding and awareness of the natural heritage and biodiversity of the county. • **P-NH-3** Protect and, where possible, enhance the plant and animal species and their habitats that have been identified under the EU Habitats Directive, EU Birds Directive, the Wildlife Act and the Flora Protection Order. **Designated Sites for Nature Conservation – Policies** • **P-DSNC-1** Protect and maintain the favourable conservation status and conservation value of all natural heritage sites designated or proposed for designation in accordance with European and national legislation and agreements. These include Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Natural Heritage Areas (NHAs), Ramsar Sites, Statutory Nature Reserves. In addition, the Council will identify, maintain and develop non-designated areas of high nature conservation value which serve as linkages or 'stepping stones' between protected sites in accordance with Article 10 of the	The application of the objectives outlined from the Draft Sligo Development Plan 2017-2023 are expected to provide positive net impacts for the protection of the natural environment through the adherence to national and international legislation. The ***Aquaculture, mariculture and fishing*** *policy* P-AMF-1 provides for sustainable fishing practices be applied across the recreational and commercial fishing sectors along the coastal waters and inland waterbodies such as Lough Talt. The ***Heritage*** objective O-H-2 and ***Natural Heritage*** policies P-NH-1, P-NH-2 and P-NH-3 objectives and policies identifies the requirement of proposed developments to take cognisance of the various national and international legislation ensuring that plans and projects put mechanisms in place to avoid any significant negative impacts occurring to qualifying interests (habitats and species) of designated sites. The ***Designated Sites for Nature Conservation*** objectives and policies identifies the requirement of proposed

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
	Habitats Directive. • **P-DSNC-2** Promote the maintenance and, as appropriate, achievement of 'favourable conservation status' of habitats and species in association with the NPWS. • **P-DSNC-3** Carry out an appropriate level of assessment for all development plans, land-use plans and projects that the Council authorizes or proposes to undertake or adopt, to determine the potential for these plans or projects to impact on designated sites, proposed designated sites or associated ecological corridors and linkages in accordance with the Habitats Directive, All appropriate assessments shall be in compliance with the provisions of Part XAB of the Planning and Development Act 2000. • **P-DSNC-4** Consider development within, or with the potential to affect, Natural Heritage Areas or proposed Natural Heritage Areas, where it is shown that such development, activities or works will not have significant negative impacts on such sites or features, or in circumstances where impacts can be appropriately mitigated. **Designated Sites for Nature Conservation – Objective** • **O-DSNC-1** Identify and protect local areas of high nature conservation value and support the management of landscape features which are of major importance for wild fauna and flora in accordance with Article 10 of the Habitats Directive. **Protected Plant and Animal Species – policies** • **P-PPAS-1** Ensure that development does not have a significant adverse impact, incapable of satisfactory mitigation on plant, animal or bird species protected by law • **P-PPAS-2** Consult with the National Parks and Wildlife Service (DAHG) and take account of any licensing requirements when undertaking, approving and authorising development which is likely to affect plant, animal or bird species protected by law. • **P-PPAS-3** Provide guidance to developers and others in relation to species protected by law and their protection and management in the context of development. **Protected Plant and Animal Species – objective** • **O-PPAS-1** Undertake surveys, as appropriate, to establish the location of protected flora and fauna in the Plan area through the County Heritage Plan and the County Biodiversity Action Plan. **Nature Conservation Outside Designated Sites – policies** • **P-NCODS-1** Minimise the impact of new development on habitats of natural value that	developments to take cognisance of the various national and international legislation ensuring that plans and projects put mechanisms in place to avoid any significant negative impacts occurring to qualifying interests (habitats and species) of designated sites. The ***Protected Plant and Animal Species*** policies and objectives and the ***Nature Conservation Outside Designated Sites*** policies and objectives identify the requirements for protection to be afforded to features of conservation interest not within designated conservation sites and for proposed developments to take cognisance of the various national and international legislation ensuring that plans and projects put mechanisms in place to avoid any significant negative impacts occurring to the features of conservation interest.

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
	are key features of the County's ecological network. Developments likely to have an adverse effect on recognised sites of local nature conservation importance will be required to demonstrate the impacts on the ecological value of the site and will not be approved unless it can be clearly demonstrated that there are reasons for the development that outweigh the need to safeguard the nature conservation value of the site. • **P-NCODS-2** Ensure that development proposals, where relevant, improve the ecological coherence of the Natura 2000 network and encourage the retention and management of landscape features that are of major importance for wild fauna and flora as per Article 10 of the Habitats Directive. • **P-NCODS-3** Ensure that proposals for development protect and enhance biodiversity, wherever possible, by minimising adverse impacts on existing habitats and by including mitigation and/or compensation measures, as appropriate, which ensure that biodiversity is enhanced. • **P-NCODS-4** Apply the *precautionary principle* in relation to development proposals with potential to impact on County Biodiversity Sites or on local nature conservation interest by requiring an ecological impact assessment (EcIA) to ensure that any proposed development will not affect the integrity and conservation value of the site. • **P-NCODS-5** Ensure that no ecological networks, or parts thereof which provide significant connectivity between areas of local biodiversity, are lost without remediation as a result of implementation of this Plan. • **P-NCODS-6** Provide guidance for developers and the general public in relation to nature conservation outside designated sites and the conservation and enhancement of biodiversity and geological heritage in general. • **P-NCODS-7** Integrate biodiversity considerations into Local Authority plans, programmes and activities where appropriate. **Nature Conservation Outside designated Sites – objectives** • **O-NCODS-1** Continue the County Habitat Mapping project, thereby generating the necessary information to identify landscape features that are of major importance for wild fauna, flora and County Biodiversity Sites, as key features of the county's ecological network • **O-NCODS-2** Identify and protect, in co-operation with the relevant statutory agencies and other relevant groups, County Biodiversity Sites which are not otherwise protected by legislation.	

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
	• **O-NCODS-3** Ensure that the findings of the county Habitat Mapping project (when completed) are utilised to inform the development management process. **Wetlands Policies** • **P-WET-1** Have regard to the County Sligo Wetlands Surveys 2008-2011 and subsequent wetland surveys that may be published during the lifetime of this Plan. Protect surveyed wetland sites that have been rated of A (International), B (National) and C+ (County) importance. • **P-WET-2** Ensure that an ecological assessment at an appropriate level is undertaken in conjunction with proposals involving drainage or reclamation of wetland habitats. **Inland Waters – Policies** • **P-INW-1** Protect rivers, streams and other water courses and their associated Core Riparian Zones (CRZs) from inappropriate development and maintain them in an open state, capable of providing suitable habitats for fauna and flora. Structures (e.g. bridges) crossing fisheries waters shall be clear-span and shall be designed and built in consultation with Inland Fisheries Ireland. • **P- INW-2** Protect and enhance biodiversity richness by protecting rivers, stream corridors and valleys by reserving land along their banks for ecological corridors, maintaining them free from inappropriate development and discouraging culverting or realignment. • **P- INW-3** Ensure that all proposed greenfield residential and commercial developments use sustainable drainage systems (SUDS) in accordance with best current practice, ensuring protection of the integrity of wetland sites in the adjoining area, including their hydrological regime. • **P- INW-4** Ensure that floodplains and wetlands within the Plan area are retained for their biodiversity and flood protection value. • **P- INW-5** Ensure that proposed developments do not adversely affect groundwater resources and groundwater-dependent habitats and species. **Inland Waters - Objectives** • **O - INW-1** Consult with prescribed bodies prior to undertaking, approving or authorising any works or development that may impact on rivers, streams and watercourses. • **O - INW-2** Require that runoff from a developed area does not result in deterioration of downstream watercourses or habitats, and that pollution generated by a development is treated within the development area prior to discharge to local watercourses.	The ***Wetlands*** policies outline the requirement to consider wetland sites that have been inventoried to date and future sites that may be identified which should be given due consideration for environmental impacts from proposed developments. The ***Inland Waters*** policies and objectives afford due protection and consideration to be given during the design of any proposed developments with regards to the maintenance and/or enhancement of their biodiversity richness and integrity of the habitats and any connected habitats via surface or groundwater vectors.

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
	Water Supply – Policies • **P-WS-1** Co-operate with Irish Water to ensure an adequate, sustainable and economic supply of good quality water for domestic, commercial and industrial use, in order to promote the development of County Sligo's settlements as set out in the Core Strategy. • **P-WS -2** Liaise with Irish Water in seeking to establish source management and protection zones around drinking water supply sources (ground and surface water) and develop appropriate management and maintenance measures for these sources. • **P-WS-3** Support the implementation of the Irish Water's Capital Investment Programmes (CIP) and Minor Works Programmes (MWP) subject to compliance with the Habitats Directive. • **P-WS-4** Facilitate the inclusion of water conservation and sustainability measures so as to minimise the use of potable water in new developments. • **P-WS-5** Where connection to a public water supply is not possible, or the existing supply does not have sufficient capacity, the provision of a private water supply will be permitted only where it can be demonstrated that the proposed water supply meets the standards set out in the EU and national legislation and guidance, and would not be prejudicial to public health or would not significantly impact negatively on the source or yield of an existing supply. **Water Quality – Policies** • **P-WQ-1** Ensure that all development proposals have regard to the **Sligo Groundwater Protection Scheme,** in order to protect groundwater resources and groundwater-dependent habitats and species. • **P-WQ-2** Strictly limit and control new development in or near the catchment areas of water bodies, particularly salmonid rivers and those that are the source of the following drinking water supplies: Lough Gill; Lough Easky; Lough Arrow; Gortnaleck and Lyle streams ; Kilsellagh Source catchment; Riverstown Source Catchment; Lough Talt; GWS Source Catchments. • **P-WQ-3** Require adherence to any **source protection plans** (or equivalent) for the above-mentioned drinking water source catchments. • **P-WQ-4** Prohibit any development which is likely to lead to the deterioration of water quality.	The ***Water Supply*** and ***Water Quality*** policies and objectives provide measures which ensure compliance with the Water Framework Directive and Flood Risk Guidelines for the protection of water resources from potential development impacts.
	<u>**Infrastructure Strategy – Roads**</u> • **RD-01** It is an objective of the Council to protect the capacity and safety of the National	A number of strategies, policies and

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
Mayo County Development Plan 2014-2020	Road Network and Strategically Important Regional Road network (listed in Appendix 4) in the County and ensuring compliance with the Spatial Planning and National Roads Planning Guidelines (January 2013). • **RD-02** It is an objective of the Council to support improvements to the existing National Road and Regional Road network including road schemes and by-passes outlined in Table 3 where it can be demonstrated that the development will not have significant adverse effects on the environment, the integrity of the Natura 2000 network or visual amenity. • **RD-03** It is an objective of the Council, in co-operation with the Department of Environment, Community and Local Government, to continue with the strengthening and improvement of the local road network including links, by-passes and relief roads, with priority given to those serving the Linked-Hub and Key Towns and interconnection between such settlements, where it can be demonstrated that the development will not have significant adverse effects on the environment or Natura 2000 network. **<u>Environment, Heritage & Amenity Strategy</u>** • **PY-03** It is the policy of the Council, in conjunction with all relevant statutory agencies, to recognise the inter-relationship between the environment (natural and cultural); the economy; and wellbeing of our citizens and thereby ensuring development in the County does not compromise the value of, or cause deterioration to, our natural and cultural resources by implementing the objectives below and the Development Guidance document of this Plan. **<u>Flooding & Soil Erosion</u>** • **FS-01** It is an objective of the Council to restrict inappropriate development in areas at risk of flooding (inland or coastal) as identified on flood risk maps, erosion and other natural hazards or would cause or exacerbate such a risk at other locations. As part of this, the Planning Authority shall require a Flood Risk Assessment and/or a Landslide Risk Assessment for any new development. **<u>Landscape Protection</u>** • **LP-01** It is an objective of the Council, through the *Landscape Appraisal of County Mayo*, to recognise and facilitate appropriate development in a manner that has regard to the character and sensitivity of the landscape and to ensure that development will not have a disproportionate effect on the existing or future character of a landscape in terms of location, design and visual prominence.	objectives are set out in the Mayo County Development Plan 2015-2021 for the protection of the natural environment. Chapter 3, *Infrastructure Strategy*, highlights the need for a National Road Network & Strategically Important Regional Road Network, while also ensuring significant adverse effects on the environment and Natura 2000 network do not occur. Chapter 4 *Environment, Heritage & Amenity Strategy* encompasses policies and objectives in relation to *Flooding & Soil Erosion, Water Quality, Landscape Protection and Natural Heritage*. A number of the policies and objective provide for the protection of the integrity of sites designated under European and National legislation and ecological works. Natural Heritage Policy NH-01 and NH-03 identify the objective of the Council to protect, enhance, conserve designated sites, along with the objective of the Council to implement Article 6(3) and 6(4) of the *EU Habitats Directive,* The *Landscape Protection* objective LP-01 highlights the need appropriate development in a manner that has regard to the character and sensitivity of the landscape

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
	• **LP-03** It is an objective of the Council to protect the unique landscape of the County which is a cultural, environmental and economic asset of inestimable value. **Natural Heritage** • **NH-01** It is an objective of the Council to protect, enhance, conserve and, where appropriate restore: a) Candidate Special Areas of Conservation, Special Areas of Conservation, Special Protection Areas, Natural Heritage Areas and proposed National Heritage Areas, Statutory Nature Reserves, Ramsar Sites and Biogenetic Reserves, including those listed in the Environmental Report documenting the Strategic Environmental Assessment of this plan and any modifications or additional areas that may be so designated during the lifetime of the plan. b) Natural habitats and plant and animal species identified under the Habitats Directive, Birds Directive, Wildlife Act and the Flora Protection Order, or any other relevant legislation that may be implemented during the lifetime of the plan. c) Features of natural interest and amenity, which provide a unique habitat for wildlife including ecological networks (including ecological corridors and stepping stones), riparian zones, hedgerows, stonewalls and shelterbelts. d) Bogs, fens and turloughs listed in the Environmental Report documenting the Strategic Environmental Assessment of this plan. e) Features of geological interest as listed in the Audit of County Geological Sites (Mayo County Council). f) The conservation value of disused railway lines, waterways, walkways *etc.* notwithstanding that some of these items (e.g. disused rail lines) may be developed at some future date as part of the County's infrastructure where it can be demonstrated that the development will not have significant adverse effects on the environment including the integrity of the Natura 2000 network. g) Surface waters, aquatic and wetland habitats and freshwater and water dependent species through the implementation of all appropriate and relevant Directives and transposed legislation. h) Trees or groups of trees protected under Tree Preservation Orders listed in the Environmental Report documenting the Strategic Environmental Assessment of this plan , as well as trees and woodlands of particular amenity and nature conservation	

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
	value, or which make a valuable contribution to the character of the landscape, a settlement or its setting. i) Sites of local conservation importance including those identified in the *Local Biodiversity Action Plan.* • **NH-03** It is an objective of the Council to implement Article 6(3) and 6(4) of the *EU Habitats Directive,* by screening all plans and projects for appropriate assessment and to ensure those with potential to have significant effects on the integrity of Natura 2000 or European Sites (SACs, SPAs), whether directly (in situ), indirectly (ex-situ) or in combination with other plans or projects, are subject to an appropriate assessment and the preparation of an NIR or NIS in order to inform decision making. • **NH-04** It is an objective of the Council to fully integrate wildlife and biodiversity considerations into all areas of the Council's roles and responsibilities and into all its works and operations. • **NH-05** It is an objective of the Council to increase awareness of the importance of the natural heritage of the County and to promote education, knowledge and pride in our natural heritage. • **NH-06** It is an objective of the Council to support the implementation of the National Biodiversity Plan. • **NH-07** It is an objective of the Council to promote best practice in the control of invasive species in the carrying out of both local authority and private development. • **NH-08** It is an objective of the Council to assist in the control of native and non-native invasive or harmful species which represent a serious threat to our environment, fresh water systems and lakes. • **NH-09** It is an objective of the Council to utilise appropriate opportunities to enhance and create wildlife habitats where they arise.	
CONSERVATION AND MANAGEMENT PLANS		
River Basin Management Plan for Ireland 2018 - 2021	Public Consultation on the River Basin Management Plan (RBMP) for Ireland (2018 – 2021), began in February 2017. The document (Chapter 4) sets out the condition of Irish waters, and a summary of status for all monitored waters in the 2013 – 2015 period, including a description of the changes since 2007 – 2009. Nationally, both monitored river water bodies and lakes at high or good ecological status, appear to have declined by 3% since 2007 – 2009; nevertheless, this figure does not reflect a significant number of improvements and dis-improvements across these waters since 2009. Provisional figures from the EPA suggest	The implementation of the RBMP and achievement or maintenance of environmental objectives which will be set for the watercourses in the River Moy catchment will have a positive impact on water dependent habitats and species within European sites. The

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
	that approximately 900 river water bodies and lakes have either improved or dis-improved. In addition, the previously observed long term trend of decline in the number of high status river sites has continued. Chapter 5 of the RBMP presents results of the catchment characterisation process, which identifies the significant pressures on each water body that is *At Risk* of not meeting the environmental objectives of the WFD. Importantly, the assessment includes a review of trends over time to see if conditions were likely to remain stable, improve or deteriorate by 2021. This work was presented in the RBMP for 81% of water bodies nationally, which had been characterised at the time. 1,517 water bodies were classed *At Risk* out of a total of 4,775, or 32%. An assessment of significant environmental pressures found that agriculture was the most significant pressure in 729 river and lake water bodies that are *At Risk*. Urban waste water, hydromorphology and forestry were also significant pressures amongst others.	proposed project will not impact on the maintenance or achievement of WFD environmental objectives subject to best practice mitigation measures being adhered to as specified in this report.
Moy Water Management Unit Action Plan	This Action Plan ascertains the status & impacts, pressures & risks associated with the Management Unit. It does not list abstractions as a viable Pressure / risk for the Water Management Unit.	Implementation and compliance with the environmental objectives of the Moy Water Management Unit Action Plan will result in net positive in-combination effects to European sites.
OTHER WATER SERVICES STRATEGIC PLANS		
Irish Water Business Plan – Transforming Water Services in Ireland to 2021.	The plan details the current status of the Irish Water Industry and the need for improvements to existing infrastructure. The current status of drinking water is outlined below. Drinking water quality • 530 of the existing 856 water treatment plants require investment. • 121 of these plants (listed as part of the EPA's Remedial Action List at the start of 2015), serving 940,000 people, require major upgrading in order to eliminate the risk of contamination of drinking water supplies, including: • 23,297 customers were on boil water notices at the start of 2015, with many more at risk due to the presence of Cryptosporidium and E.coli. • At least 180,000 properties at risk of failing European standards for lead in drinking water at the start of 2015. • Irish Water still retains large open reservoirs for drinking water storage that require additional treatment processes to ensure water quality.	Elements of the proposed improvement construction works to water and wastewater infrastructure have the potential to impact the receiving and local environment during the construction phase for each project. However, the proposed upgrades and the secure transit and storage of water through improved infrastructure will provide a net positive impact due to water conservation and more effective treatment of wastewater.

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
	This is a key objective of the Irish Water Business Plan and Capital Investment Plan and is in compliance with the Direction received from EPA to upgrade the level of treatment in the Lough Talt RWSS and ongoing Boil Water Notices to meet the prescribed standards to satisfy public health needs. Funding is in place for the project on the current Capital Investment Plan, which has been approved by the Economic Regulator.	
	POLLUTION REDUCTION PLANS	
IPPC Programme **Local Authority Discharge** **Groundwater Pollution Reduction Programmes** **Surface Water Pollution Reduction Programmes**	There is one IPPC licenced facility between Lough Talt and Lough Conn, approximately 16.52km north-west of Lough Talt; Reg. No: P0918-01 Applicant: Hollister ULC Main Class of Activity: 12.2.2 Surface Coatings. Other than this exception, there are no IPPC Licence holders discharging to proximal or downstream European sites. There are 4. no discharge licences or discharge licence applications in the vicinity of the European sites. Programmes are being implemented the River Basin Management Plans in accordance with international and national legislation to satisfy the criteria set out under the Water Framework Directive. These programmes and their associated legislative mechanisms are identified within the Pollution Reduction Plans of the *Register of Plans and Programmes Background Document to the River Basin Management Plans in accordance with Article 13(3) of the European Communities (Water Policy) Regulations 2003 (S.I. No 722 of 2003)*[4].	Policies for both the Groundwater and Surface water Pollution Prevention Programmes provide for measures to be taken for developments to put steps in place to avoid any negative impacts to aquifer and surface water bodies that could potentially result in negative impacts to the natural environment. The implementation of these pollution reduction programmes will result in a net positive benefit to the natural environment.
	MAJOR ACCIDENT EMERGENCY PLANS	
Seveso II Sites	One Seveso II site was identified within the Mayo County Development Plan assessments[5]; Ballina Beverages, Brooklands Gas Co. Ltd. Located in Ballina town, County Mayo. Aside from this site, there are no Seveso II Sites in the vicinity of the proposed Lough Talt WTP.	The single Seveso II Site is not within close enough proximity to cause any likely impacts with the proposed abstraction works or WTP. The Seveso II Directive (Directive 96/82/EC) (as amended) also provides for measures to ensure a Seveso site's compliance with

[4] http://www.wfdireland.ie/docs/Register_Plans_Programmes.pdf
[5] Environmental Report of Strategic Environmental Assessment of *Draft* Mayo County Development Plan 2014 – 2020 (http://www.mayococo.ie/en/Planning/MayoCountyDevelopmentPlan2014-2020/Document2,24889,en.pdf)

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
		best practice and avoid any potential vectors/triggers that may potentially result in negative impacts to the surrounding designated sites.
	FOREST MANAGEMENT PLANS	
Coillte West Business Area Unit 2(BAU) Strategic Plans 2016-2020	In the West BAU, Coillte aims to maintain and enhance the percentage of broadleaves in the BAU managed for biodiversity. Coillte's Policy on water protection and water monitoring is outlined in "Water Protection and Forest Operations Guidelines" document. This document outlines current best practice in minimising the impacts of forest operations on water quality.	The implementation of both Strategic Plans and the Indicative Forestry Statement provides security that all endeavours within Coillte properties will be compliant with relevant natural environment legislation.
	FISHERIES PLANS	
Inland Fisheries Ireland Corporate Plan 2016 -2020 **The Inland Fisheries Act 2010.**	• To ensure that Ireland's fish populations are managed and protected to ensure their conservation status remains favourable. That they provide a basis for a sustainable world class recreational angling product, and that pristine aquatic habitats are also enjoyed for other recreational uses. • To develop and improve fish habitats and ensure that the conditions required for fish populations to thrive are sustained and protected. • To grow the number of anglers and ensure the needs of IFI's other key stakeholders are being met in a sustainable conservation focused manner. • We will invest in our people to achieve operational excellence and become one of the best places to work • IFI will promote a culture of value for money and continual evaluation of its performance in a measurable, transparent and accountable manner. Inland Fisheries Ireland's (IFI) Corporate Plan 2016-2020 sees IFI setting out ambitious goals to drive its work around the protection, conservation, promotion and development of Ireland's fisheries resource over the next five years. Among these goals is the growth of angling with a view to increasing the number of domestic and international anglers in Ireland. Angling in Ireland is currently worth €836 million to Ireland's economy annually, supporting upwards of 11,000 jobs. IFI's Corporate Plan also focuses on the protection and conservation of freshwater fish species in Ireland and it outlines how modern protection services incorporating technology	Implementation and compliance with the goals of the IFI corporate plan will result in net positive in-combination effects to European sites

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
	will efficiently protect the resource. Staff have recently adopted new technologies to help them protect Ireland's rivers and lakes with Fisheries Officers now routinely using equipment such as spotting scopes, night sights, thermal imaging equipment and mobile phone apps to assist them in their work. They are also using kayaks, all-terrain vehicles, quads and bikes on fisheries patrols.	
	OTHER PLANS AND PROJECTS	
Flood Risk Management Plans	The Western Catchment Flood Risk Assessment & Management (Western CFRAM) Study[6] contains the reporting and plans that should be consulted and suggested measures applied by the applicants to avoid negative impacts from the proposed coastal protection works.	The programme of measures resulting from the CFRAM study may perpetuate significant effects on European sites (However, the overarching policies and objectives of **Sligo County Development Plan 2017 – 2013** including policies **P-NH-1** to **P-NH-3, P-DSNC-1** to **P-DSNC-4, P-WS-1** to **P-WS-5, P-WQ-1** to **P-WQ-4** and objectives **O-DSNC-1, O-INW-1** and the **Mayo County Development Plan 2014 - 2020** These will include the requirement for any development taking place within the city to undergo Screening for AA and/or Habitats Directive Assessment where necessary and in doing so to demonstrate that the project will not give rise to any significant adverse direct, indirect or secondary effects on the integrity of any European site. No negative in-combination effects to European sites are expected through the implementation of CFRAM.

[6] http://www.westcframstudy.ie/

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO THE RIVER MOY SAC	IMPACT ASSESSMENT
Local Planning Applications[7]	**Planning Ref no (12/149)** Conditional permission granted to John Scott Gortersluin, Aclare, Co. Sligo to remove an existing septic tank to replace this with a new proprietary effluent treatment (p.e.t.) system and polishing filter.	Adherence to the overarching policies and objectives of the **Draft Sligo County Development Plan 2017 – 2013** and the **Mayo County Development Plan 2014 - 2020** ensure that local planning applications comply with the core strategy of proper planning and sustainability and with the requirements of relevant EU Directives and environmental considerations, there is no potential for adverse in combination effects on European sites.
	Planning Ref no (14/394) Ellis McGuire, Gortersluin, Co. Sligo; Development consisting of the construction of 1 number bellmouth entrance with access road so as to facilitate access into existing forestry plantations for the removal of timber and all ancillary works (ongoing).	
	Planning Ref no (12/343) Conditional permission granted to Joe and Breege Mullarkey, Glenawee, Aclare, Co. Sligo for the construction of an extension to the side of existing dwelling house, new effluent treatment system with percolation area as well as planning permission to retain existing bay window on the front elevation of dwelling house together with all ancillary site works and services.	
	Planning Ref no (10/124) Condition permission granted to Cian Deehan Glenawoo, Aclare Co. Sligo for the construction of extensions totalling 57.85sqm to North-East, North-West, South-West & South-East sides of existing house together with all other necessary site works.	
	Planning Ref no (16/72) Conditional permission granted to David Sheerin for the erection of 2300 metres of wire fencing to a height of 1.2 metres consisting of one strand of barbed wire over 800mm high sheep wire using tantalised 100mm diameter round timber posts at five metre intervals, and 200mm diameter tantalised timber strainer posts as required (a Natura Impact Statement has been prepared with respect to the development, since the land is within The Lough Nabrickkeagh Bog, Special Protection Area (SAC)).	
OTHER PRESSURES		
Landslides and Water Quality	During aquatic surveys conducted in 2016, considerable levels of silt were recorded covering the lake substrate. Some of this silt may have originated from a landslide that took place on the hill to the west of Lough Talt during early September 2010. Filamentous algae was also recorded growing on the hard substrata at all sites examined. This suggests pollution in the form of enrichment.	Potential in-combination effects

[7] The proposed developments supporting effluent treatment systems are unlikely to contribute impacts to receiving surface or groundwater habitats and thus will not result in net impacts to the Eighnagh River or the River Moy SAC. Other proposed developments such as the removal of conifer plantation could, in the absence of best practice and mitigation result in impacts to receiving downstream watercourses within the River Moy SAC catchment.

4.2.2 Assessment of Likely Changes to European Sites

This section of the Screening for AA assesses the likely changes to European Sites within the project ZoI. Each assessment criterion follows those provided in the European Commission's methodological guidance (EC, 2002).

4.2.2.1 Describe any likely changes to the site arising as a result of the following:

Reduction of Habitat

The construction of the proposed WTP upgrade will not result in habitat loss to European sites. However, the continued abstraction from Lough Talt could impact upon the hydrological and hydrogeological interactions of water dependent calcareous fen habitats adjoining Lough Talt that in turn support Geyer's whorl snail (*Vertigo geyeri*), a species of qualifying interest for Lough Hoe Bog SAC.

The cessation of abstraction of 8MLD from Lough Talt may affect the surface water and groundwater regime of the lake and river outflow, and may impact the dependent habitats and species of the Lough Hoe Bog SAC and the River Moy SAC.

Disturbance to Key Species

Any uncontrolled discharges or release of pollutants during the SI works and / or the construction, operation and decommissioning of the WTP upgrade to the Eighnagh River could affect qualifying habitats and species where present. This would result in possible impacts on the River Moy SAC. In addition, continued abstraction could result in the reduction in suitable habitat quality and consequent disturbance of white-clawed crayfish and *V. geyeri* populations within or adjacent to Lough Talt. Approximately 300m of the Eighnagh River downstream of the Lough Talt outflow dries out on an annual basis. This would result in habitat and consequent species fragmentation for white-clawed crayfish within the Eighnagh River, a species of qualifying interest for the River Moy SAC.

Habitat or Species Fragmentation

The continued abstraction from Lough Talt may result in the reduction in suitable habitat quality through continued water drawdown or exacerbation of drought conditions, resulting in the fragmentation of suitable habitats used by white-clawed crayfish and *V. geyeri* populations within Lough Hoe Bog SAC. The continued abstraction may contribute to the drying out of a 300m stretch of the Eighnagh River downstream of the Lough Talt outflow. This would result in habitat and consequent species fragmentation for white-clawed crayfish within the Eighnagh River, a species of qualifying interest for the River Moy SAC.

The cessation of the abstraction of 8MLD from Lough Talt will potentially increase the levels in the lake as well as the discharge from the lake to the Eighnagh River. The outflow to the river is proportional to the lake level so the cessation of the abstraction will initially lead to a slight increase in lake levels but ultimately will lead to increased outflows from the lake. Therefore the cessation of abstraction of raw water from Lough Talt is not likely to have a significant effect on the conservation objectives of the Lough Hoe Bog SAC and the River Moy SAC.

Reduction in Species Density

Any uncontrolled discharges or release of pollutants during the SI works and / or the construction, operation or decommissioning of the WTP upgrade to the Eighnagh River could affect qualifying habitats and species where present. This would result in possible impacts on the River Moy SAC. In addition, continued abstraction could result in the reduction in suitable habitat quality and potential reduction in species density of white-clawed crayfish and *V. geyeri* populations within or adjacent to Lough Talt and white-clawed crayfish populations in Eighnagh River.

Changes in Key Indicators of Conservation Value

The water quality of the Eighnagh River (River Moy SAC) can be considered a key indicator of conservation value. However, there will be no process wastewater discharge as a result of the proposed water treatment works. All backwash waters will be recirculated to the head of the plant for treatment. Surface water will be collected, attenuated and discharged via a hydrocarbon interceptor to the existing drainage channels on-site which ultimately discharge to the Eighnagh River. However, continued abstraction may contribute to the temporary drying out of the Eighnagh River removing suitable habitat and refuge for in-situ white-clawed crayfish.

Key indicators of Conservation Value for Lough Hoe Bog SAC include the ecological, hydrological and hydrogeological integrity of its habitats and dependent species. Continued abstraction from Lough Talt may impact the hydrological functioning of the lake and impact the species supported by the lake including the white-clawed crayfish population and changes to the hydrogeological functioning the rich calcareous fen habitat which historically supported *V. geyeri*.

Climate Change

The proposed WTP upgrade will not result in significant negative effects contributing to climate change that could in turn affect the conservation objectives of the River Moy SAC or Lough Hoe Bog SAC.

4.2.2.2 Describe any likely impacts on the European site as a whole in terms of Interference with key relationships that define the structure and function of the site

European sites form part of the extensive mosaic of freshwater, wetland and terrestrial ecosystems in the locality. Water quality and the extent and quality of habitats are considered to be key environmental conditions that support the integrity of the River Moy SAC and Lough Hoe Bog SAC. The risks associated with this project include a possible reduction in water quality in the Eighnagh River, which is designated as part of the River Moy SAC, as part of the SI works and during the project's construction phase. In addition, the project operational phase risks degradation of water dependent habitats at Lough Talt and the Eighnagh River with potential knock on effects to species of qualifying interest associated with Lough Hoe Bog SAC and River Moy SAC respectively.

The cessation of the abstraction of 8MLD from Lough Talt will potentially increase the levels in the lake as well as the discharge from the lake to the Eighnagh River. The outflow to the river is proportional to the lake level so the cessation of the abstraction will initially lead to a slight increase in lake levels but ultimately will lead to increased outflows from the lake. Therefore the cessation of abstraction of raw water from Lough Talt is not likely to have a significant effect on the conservation objectives of the Lough Hoe Bog SAC and the River Moy SAC.

4.2.2.3 Provide Indicators of significance as a result of the identification of effects set out above in terms of:

Loss

The proposed abstraction could result in loss or change of wetland habitat supporting qualifying interest species of Lough Hoe Bog SAC, through surface water drawdown and changes in the groundwater regime at Lough Talt. The continued abstraction may also contribute to the temporary drying out of the Eighnagh River removing suitable habitat and refuge for in-situ white-clawed crayfish population, a qualifying interest species of the River Moy SAC.

The cessation of water abstraction during the decommissioning stage may have a positive impact on habitats that support White-clawed Crayfish and *Vertigo geyeri*, as pressures on the habitats that support these species are exacerbated by the abstraction during drought conditions.

Fragmentation

The proposed abstraction could result in the hydrological or hydrogeological changes to Lough Talt that may in turn result in fragmentation of water dependent habitats and species of qualifying interest for Lough Hoe Bog SAC. The continued abstraction may contribute to the drying out of a 300m stretch of the Eighnagh River downstream of the Lough Talt outflow. This would result in habitat and consequent species fragmentation for white-clawed crayfish within the Eighnagh River, a species of qualifying interest for the River Moy SAC.

The cessation of water abstraction during the decommissioning stage may have a positive impact on habitats that support White-clawed Crayfish and *Vertigo geyeri*, as pressures on the habitats that support these species are exacerbated by the abstraction during drought conditions.

Disruption

The proposed abstraction could result in the hydrological or hydrogeological changes to Lough Talt that may in turn result in the disruption of the hydrological regime of the water dependent species of qualifying interest for Lough Hoe Bog SAC. The continued abstraction may contribute to the drying out of a 300m stretch of the Eighnagh River downstream of the Lough Talt outflow. This drying out during critical time of the year when the juveniles are released (between June and August) may disrupt the life cycle of white-clawed crayfish within the Eighnagh River, a species of qualifying interest for the River Moy SAC.

The cessation of water abstraction during the decommissioning stage may have a positive impact on habitats that support White-clawed Crayfish and *Vertigo geyeri*, as pressures on the habitats that support these species are exacerbated by the abstraction during drought conditions.

Disturbance

The proposed abstraction could result in the hydrological or hydrogeological changes to Lough Talt that may in turn result in the disturbance of water dependent habitats and species of qualifying interest for Lough Hoe Bog SAC. The continued abstraction may contribute to the drying out of a 300m stretch of the Eighnagh River downstream of the Lough Talt outflow. This would result in the disturbance of white-clawed crayfish within the Eighnagh River, a species of qualifying interest for the River Moy SAC.

The cessation of water abstraction during the decommissioning stage may have a positive impact on habitats that support White-clawed Crayfish and *Vertigo geyeri*, as pressures on the habitats that support these species are exacerbated by the abstraction during drought conditions.

Change to key elements of the site

It is likely that the magnitude, intensity and integrity of changes to key elements of the European sites in this respect will be localised but nonetheless significant. Examples of key elements subject to change are water resources, water quality and species population density. Where changes do occur the impact will be significant for the duration of the impact if appropriate measures are not put in place.

The cessation of water abstraction during the decommissioning stage may have positive effect on the surface water and groundwater regime of the lake and Eighnagh River, and may impact the water dependent habitats and species of the Lough Hoe Bog SAC and the River Moy SAC. The cessation of abstraction may have a positive impact on habitats that support White-clawed Crayfish and *Vertigo geyeri* particularly during drought conditions, as pressures on the habitats that support these species are exacerbated by the abstraction during drought conditions.

4.2.2.4 Describe from the above those elements of the project or plan, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts is not known.

Potential impacts to European sites forming part of the Natura 2000 network as a result of proposed project have been examined through this assessment. Two European sites are present within the identified ZoI that support direct and indirect connectivity to the development and likely significant effects have been identified. The project supports indirect connectivity with Lough Hoe Bog SAC through the proposed abstraction and both direct and indirect connectivity to the River Moy SAC through the proposed abstraction and the potential drying out of the Eighnagh River and indirect connectivity between on-site drainage channels, surface water flow and the nearby sections of the Eighnagh River.

The cessation of water abstraction during the decommissioning stage may have positive effect on the surface water and groundwater regime of the lake and Eighnagh River, and may impact the water dependent habitats and species of the Lough Hoe Bog SAC and the River Moy SAC. The cessation of abstraction may have a positive impact on habitats that support White-clawed Crayfish and *Vertigo geyeri* particularly during drought conditions, as pressures on the habitats that support these species are exacerbated by the abstraction during drought conditions.

4.2.3 Screening for Appropriate Assessment Conclusion

The significance of potential impacts needs to be investigated further to quantify and qualify such potential impacts. It is considered that there is potential for impacts to Lough Hoe Bog SAC due to the continued abstraction for 10 years, in addition to potential impacts to the River Moy SAC through surface water connectivity and water drawdown in the Eighnagh River as a result of continued abstraction and pollution entering the watercourse during the construction stage of the WTP upgrade. Furthermore, potential impacts as a result of decommissioning needs to be assessed. Therefore, the potential impacts to both European Sites will be considered further in the Natura Impact statement to inform the AA.

AA in line with Article 6(3) of the European Habitats Directive (92/43/EEC) is therefore required.

5 STAGE 2 - NATURA IMPACT STATEMENT

The findings of the Screening for AA identified direct and indirect connectivity between the project and two European sites; i.e. Lough Hoe Bog SAC and the River Moy SAC. Due to this connectivity, there is potential for impacts during the project construction, operational and decommissioning phases that may result in impacts to habitats and species of qualifying interest for Lough Hoe Bog SAC. Potential impacts and key best practice and mitigation measures for these European sites, their habitats and species of qualifying interest and conservation objectives are assessed in greater detail in this section.

Section 5.1 of this Chapter presents commentary on the existing environment of the proposed WTP upgrade and the Lough Talt area and its environs.

5.1 EXISTING ENVIRONMENT

5.1.1 Habitats in the Existing Environment

The habitats found within the study area of Lough Talt comprise Lough Talt itself, classified as an oligo-mesotrophic lake. According to O'Connor (2015), it is impossible to distinguish between the Oligotrophic lake (Annex I habitat [3110]) and Oligo-mesotrophic lake (Annex I habitat [3130]) based on vegetation community alone. Oligotrophic lakes [3110] are identified within the Lough Hoe Bog SAC Conservation Objectives (NPWS, 2017); however, these are stated to be associated with upland peatland locations, while Lough Talt is specifically not included within this Annex I qualifying interest. It appears that the closest association would be the Oligo-mesotrophic lake habitat [3130], based on the vegetation community and the updated interpretation of this habitat (O'Connor, 2015).

Additional environment contributors leading to this classification include the fact that Lough Talt is characterised by low nutrient water chemistry and calcareous groundwater inputs, i.e. circum-neutral, with conductivity at the lower end of calcareous lakes normally assigned as Annex I lake type 3140 'hard oligo-mesotrophic lakes with *Chara*'. Orthophosphate values are consistently in line with 'high status' requirements; however, algal blooms recorded during surveys to inform this NIS as well as for previous fisheries surveys (IFI, 2014) identifies nutrient inputs. Similarly the IFI WFD fisheries studies completed in the lake between 2009 to 2014 (IFI, 2014) have identified that growth and productivity for brown trout is slow, indicating a low nutrient environment, although fisheries WFD status is assessed as 'good'. Notably, the presence of Arctic char correlates with 3130 Oligo-mesotrophic waters (O'Connor, 2015). Water level fluctuations are attributed to the maintenance of the 3130 community; however, lakes affected by such fluctuations should not be included within the Annex I habitat classification (O'Connor, 2015). Paleolimnological sampling at Lough Talt has indicated an alteration in the natural lake level fluctuation and diatom community, occurring from 1950 onwards. Anthropogenic water level impacts at Lough Talt therefore preclude the assignment of this lake within the Annex I 3130 habitat classification.

The shores and margins of the lake support a variety to habitats including rich fen and flush, agricultural grassland, calcareous grassland, wet grassland, marsh and wet heath. Wet heath can be found at several locations around the lake, often forming mosaic with other habitat types; including wet grassland and cutover bog. There is a small area of cutover bog on the northern shores of Lough Talt. Turf banks indicate a history of peat extraction at the site. The areas of modified upland blanket bog habitat, that have been cut have re-vegetated with varying assemblages of species, depending on hydrology, depth of peat remaining, nature of the peat and underlying substratum.

Lough Talt is drained by the Eighnagh River, which is a small fast flowing stream which flows in a south westerly direction from the south of Lough Talt. The Eighnagh River is designated under the River Moy SAC. The Eighnagh River provides suitable habitat for a number of Annex II species including Atlantic Salmon (*Salmo salar*), Brook Lamprey (*Lampetra planeri*) and White-clawed Crayfish (*Austropotamobius pallipes*). Full details on the habitats found in Lough Talt are provided in **Appendix E**.

5.1.1.1 Habitats at Proposed Water Treatment Plant Location

The proposed WTP upgrade site is set within the footprint of the existing Lough Talt RWSS WTP. This area supports the existing built infrastructure of Lough Talt RWSS WTP which includes operations buildings, holding tanks, boundary walls some built ground to facilitate vehicular access. The fringes of the WTP site support amenity grassland, in addition to sections of unmanaged grassland that support a mosaic of dry meadows and grassy verge and wet grassland habitat. The proposed WTP upgrade site is set within an area dominated by recently felled conifer plantation and mature conifer plantation to the south. The WTP is situated on relatively steep sloping ground, located on the higher reaches of the Eighnagh river valley located less than 100m south. The footprint of the proposed WTP upgrade does not support drainage channels that form connectivity to the Eighnagh River, however surface water connectivity between both areas could be attained via overland flow.

5.1.1.2 Habitats at the Proposed Mitigation Site

The proposed mitigation site is located on the north eastern shore of Lough Talt which supports calcareous fen habitat with sedge-rich, mossy seepage zones. The site historically supported *Vertigo geyeri*, a species of qualifying interest for Lough Hoe Bog SAC. The botanical species found within this habitat include includes Common Butterwort *(Pinguicula vulgaris*), Grass of Parnassus *(Parnassia palustris),* Devils-bit Scabious (*Succisa pratensis),* Sedge species*,* Horsetail *(Equisetum palustris),* Yorkshire Fog *(Holcus lanatus),* Quaking Grass *(Briza media)* and moss (*Drepanocladus revolvens).*

The optimum habitat areas that support *Vertigo geyeri* are within a wider mosaic of heather hummocks and denser vegetation, and are specific to emergent seepages, where they typically fit the characteristic vegetation classification within the *Caricion davallianae* alliance, characteristically being distinguished by *Carex viridula, Parnassia palustris, Campylium stellatum, Drepanocladus revolvens, Orchis mascula, Eleocharis quinqueflora, Pinguicula vulgaris, Carex panicea, Schoenus nigricans, Briza media, Succisa pratensis, Equisetum palustris, Mentha aquatica, Hydrocotyle vulgaris, and Menyanthes trifoliata* (Rodwell, 1991).

The Rich Fen and Flush PF1 habitat corresponds to the Annex I Alkaline fens (7230). Alkaline Fens are not a qualifying habitat of Lough Hoe Bog SAC; however the habitat is of ecological significance, not only for the botanical diversity it supports but also the rich assemblage of invertebrates, including Annex II species, *V. geyeri,* a qualifying interest of Lough Bog SAC; however the species has not been recorded at Lough Talt since 2007.

Figure 5-1: Habitats within and surrounding Lough Talt

5.1.2 Hydrology and Water Quality

5.1.2.1 Catchment Description and Hydrology

Lough Talt is located in the Ox Mountains in south-west Co. Sligo, approximately 13km northwest of Tobercurry. Lough Talt (WFD Code IE_WE_34_405) has a surface area of just under 1km^2 and is approximately 140m Above Sea Level (A.S.L). The R294 Tobercurry – Ballina regional road runs along the eastern shore of the lake. The main influent watercourse to Lough Talt is the 2nd order stream that flows into the north western side of the lake. This stream drains the townland of Tawnyany and is referred to as the Tawnyany stream in this report. This stream has a channel length of approximately 2km and has a wetted width of approximately 1.5 meters as it enters Lough Talt. The only other watercourse indicated on Ordnance Survey mapping that feeds into Lough Talt is the 1st order stream that enters the lake from the townland of Gortersluin, on the north eastern shore of the lake. This stream is minor and was almost dried out when examined during the 2010 survey undertaken by Ecofact Environmental Consultants.

Lough Talt is drained by the Eighnagh River (WFD Code 34E010100). The outflow is located at the southern tip of the lake and at this location the river is crossed by a local road that runs along the southern shore. The existing drinking water supply intake is located near the outflow. There is also a hydrometric station in the form of a staff gauge at the bridge over the outfall (Station No. 34076). Approximately 0.5km downstream of Lough Talt in the townland of Larbaun, the Eighnagh River is joined by the 3rd order Lough Hoe River. Lough Talt has a surface water area of 90 hectares with an associated catchment area of 500 hectares.

The area of the Eighnagh River catchment upstream of the Lough Hoe confluence is 5km^2. The 50%ile flow is estimated as 0.13m^3/s. The 80%ile and 95%ile flows of the river at this location are 0.04m^3/s and 0.014m^3/s, respectively (EPA Hydrotool). The Lough Hoe River is slightly larger than the Eighnagh River having a 50%ile flow estimated as 0.131m^3/s (EPA Hydrotool) just upstream of the confluence with the Eighnagh River. The Lough Hoe River drains the area to the south of Lough Talt including Blind Lough, Lough Nalackagh, Lough Hoe and Fossea Lough, an area of approximately 6.1km^2.

Downstream of the Lough Hoe River confluence, the Eighnagh River is fast flowing and eroding. In the stretch from Lough Talt to 2km downstream, the river falls approximately 60 metres. From Lough Talt, the river generally flows in a south-easterly direction for approximately 3.5km draining some lands under coniferous forestry. Thereafter, the Eighnagh River generally flows in a southerly direction being fed by numerous 1st order streams from the west, most draining the eastern slopes of the Ox Mountains. Approximately 8km downstream of Lough Talt, the 3rd order Faghany River flows into the Eighnagh River from the west to form a 4th order watercourse. The Lenane River flows into the Faghany River upstream of the Eighnagh River.

Approximately 1km downstream of the Faghany confluence, the Eighnagh River flows through Aclare. Approximately 1.5km downstream of Aclare, the Eighnagh River is fed from the east by the 3rd order Bellanamean River (WFD Code 34B040500) and the 2nd order Littlefish River as well as the 1st order Maghera River from the east. From this point downstream, the Eighnagh River flows into the River Moy approximately 3km south-east of Aclare. The channel length of the Lough Talt/Eighnagh River from Lough Talt to the River Moy is approximately 15km. Approximately 0.5km upstream of its confluence with the River Moy, the Eighnagh River is crossed by a third class road at Cloongoonagh Bridge.

The area surrounding Lough Talt comprises predominantly of blanket peat (particularly in the Lough Hoe River catchment). Brown earths have formed closer to the lake shores with the exception of the south west side where the soil type is described as scree (EPA, 2010). The brown earth formation continues down through the catchment of the Eighnagh River alongside sections of cut-raised bog. Land cover in the area is a mix of peat bogs and pastures with some areas of coniferous forest.

5.1.2.2 WFD Risk Characterisation

The Water Framework Directive Risk Assessment Working Group in Ireland has adopted a four category risk classification scheme (Anon, 2004). This scheme is presented below in **Table 5.1**. The hydrological risk assessment threshold for rivers and lakes from the same report is provided in **Table 5.2**. Based on these tables it would be required that the abstraction rate does not result in a change of more than 10% of the natural 95%ile flow in the river to ensure that the river maintains a status of at least Category 2a, or ‘probably not at Risk’. It would be required that the abstraction rate does not result in a change of more than 5% of the natural 95%ile flow in the river to ensure that the river maintains a status of Category 2b, or ‘Not at Risk’. These characterisations are relevant with regard to the maintenance of ‘good ecological status’ within Lough Talt and the Eighnagh River, both of which are within European sites, containing Annex II listed water-dependant species for which these sites are designated.

The WFD *WaterMaps* information system was developed to support the River Basin Management Plans during Cycle 1 of the WFD between 2009 and 2015. This information system presents data on water body status (between 2007 and 2009), risks (based on the Article V risk assessment undertaken in 2005), objectives and measures (set in 2009), and presents this data as colour coded maps from which detailed water body reports can be downloaded.

The 95%ile flow of the stretch of the Eighnagh River downstream of Lough Talt is $0.014m^3/s$. The current abstraction is greater than 40% of the 95%ile flow and this places Lough Talt in the 1a (at risk) category. Therefore, Lough Talt and downstream river water bodies were characterised as being (1a) ‘*At Risk’* during the 2005 Article V Characterisation process under the WFD, which was attributed to abstraction pressures. A National Programme of Measures and Standards Study was also undertaken subsequently to examine abstraction pressures at 127 lakes judged to be ‘at risk’ or ‘potentially at risk’ in the Article V initial characterisation. This included Lough Talt. Lough Talt was one of the 78 lakes which remained in the ‘at risk’ category following this more detailed assessment.

An updated risk characterisation is currently being finalised by the EPA for the Cycle 2 of river basin management planning. The process for determining the risk classification of a water body has been changed substantially since Cycle 1 of river basin management planning. Discussions with the EPA have indicated that Lough Talt will be placed *At Risk*, primarily due to deterioration in status from *high* to *good status* in the period between 2009 and 2015.

Table 5.1: Risk Classifications

Category	Description
1a	At risk
1b	Probably at risk
2a	Probably not at risk
2b	Not at risk

Table 5.2: Risk Assessment Thresholds for Rivers and Lakes

	2b	2a	1b	1a
Rivers - 95%ile flow, high sensitivity	<5%	5-10%	10-40%	>40%
Lakes - 95%ile flow, high sensitivity	<10%	10-15%	15-40%	>40%

Using the UKTAG (2008) hydrological risk assessment methodology for salmonid spawning and nursery areas, the maximum permitted amount of change from the natural flow during flows of less than QN_{80} (natural 80%ile flow) during the period November to March is 7.5% for maintaining 'Good Ecological Status'. The corresponding maximum change permitted during the period April to October is 10%. The higher standard for the period November to March is primarily designed to protect spawning and early life history stages of salmonids. It is stated in UKTAG that '*where abstractions are of the scale of 60-70% of the QN95, river flows are likely to fall to zero for a few days per year. It is clear when a river dries up that this causes serious environmental impacts*'.

The invert bed level of the Eighnagh River channel at the outlet of Lough Talt is 135.5maod which has been calculated using available Lough Talt topographical survey information. Under the existing abstraction rates of 8 MLD, during dry periods, the lake level drops below 135.5maod and the Eighnagh River dries out between the outflow from the lake to the river to its confluence with the Lough Hoe River 300m downstream. There are indications that there is no flow from Lough Talt to the Eighnagh River for 39 days of an average year between July and October.

5.1.2.3 Water Quality

5.1.2.3.1 Lough Talt

Lough Talt and the Lough Talt/Eighnagh River lie within the Western River Basin District. It is part of the *Moy and Killala Bay Catchment* and the subcatchment 34_SC_020.

The status of Lough Talt has declined from *high* (between 2007 and 2009) to *good status* (in 2010 and 2012), and remains at *good status* in the latest assessment undertaken by the EPA (2013 to 2015) (**Figure 5.2**), with the ecological status being driven by the fish assessment undertaken by Inland Fisheries Ireland (IFI) for the latest round of assessment. The Environmental Quality Ratio (EQR) was 0.786 in 2008, 0.859 in 2011 and 0.748 in 2014. The high/good boundary is set at 0.76, therefore the lake has just moved into the good status class in 2014. Lough Talt is one of a few example lakes which are hovering around the high / good boundary (IFI, *pers. comm*.). There was a decrease in the native Biomass per Unit Effort (BPUE) and an increase in the total BPUE together with an increase in the percentage biomass of perch. Brown trout have successfully reproduced in the lake on all occasions it has been surveyed by IFI in recent years. The mean abundance and biomass of Arctic char (Lough Talt holds the only population of this species in the Moy catchment) also fluctuated slightly over the past three sampling events, however these differences were not statistically significant (IFI, 2015). IFI are currently classifying Arctic char populations into risk categories and preliminary discussions with IFI have indicated that Lough Talt will be placed at risk due to its small population, downward trend in population size and pressures due to abstraction (IFI, *pers. comm*.).

Blind Lough, Lough Nalackagh, Lough Hoe and Fossea Lough are currently not monitored by the EPA.

Lough Talt falls into typology Class 8 (as determined by the EPA for the WFD), i.e. deep (mean depth >4m), greater than 50ha and with moderate alkalinity (20- 100mg/l $CaCO_3$). The EPA carry out physico-chemical analysis of water samples collected from Lough Talt by Sligo County Council as part of the National Lakes Monitoring Programme. General physico-chemical parameters are assessed on a pass / fail basis and include the analysis of generic determinants such as temperature, dissolved oxygen, BOD, conductivity, hardness, phosphorus, nitrogen, pH and alkalinity. Results for the period 2013 - 2015 indicate that Lough Talt passes for these general conditions. Water sampling results from Sligo County Council are presented in the **Table 5.3** below.

Lough Talt failed its chemical status assessment in the period 2013 to 2015. The failure was as a result of PAHs or Polycyclic aromatic hydrocarbons. Concentrations of PAHs are on the increase in Ireland with the major source being residential combustion of solid fuels (EPA, 2016[8]). PAHs are a ubiquitous and persistent hazardous substance. Measures however to control impacts from PAHs will need to be at the national level in order to deliver reduced detection in the environment and therefore local level measures are likely not to result in required reductions.

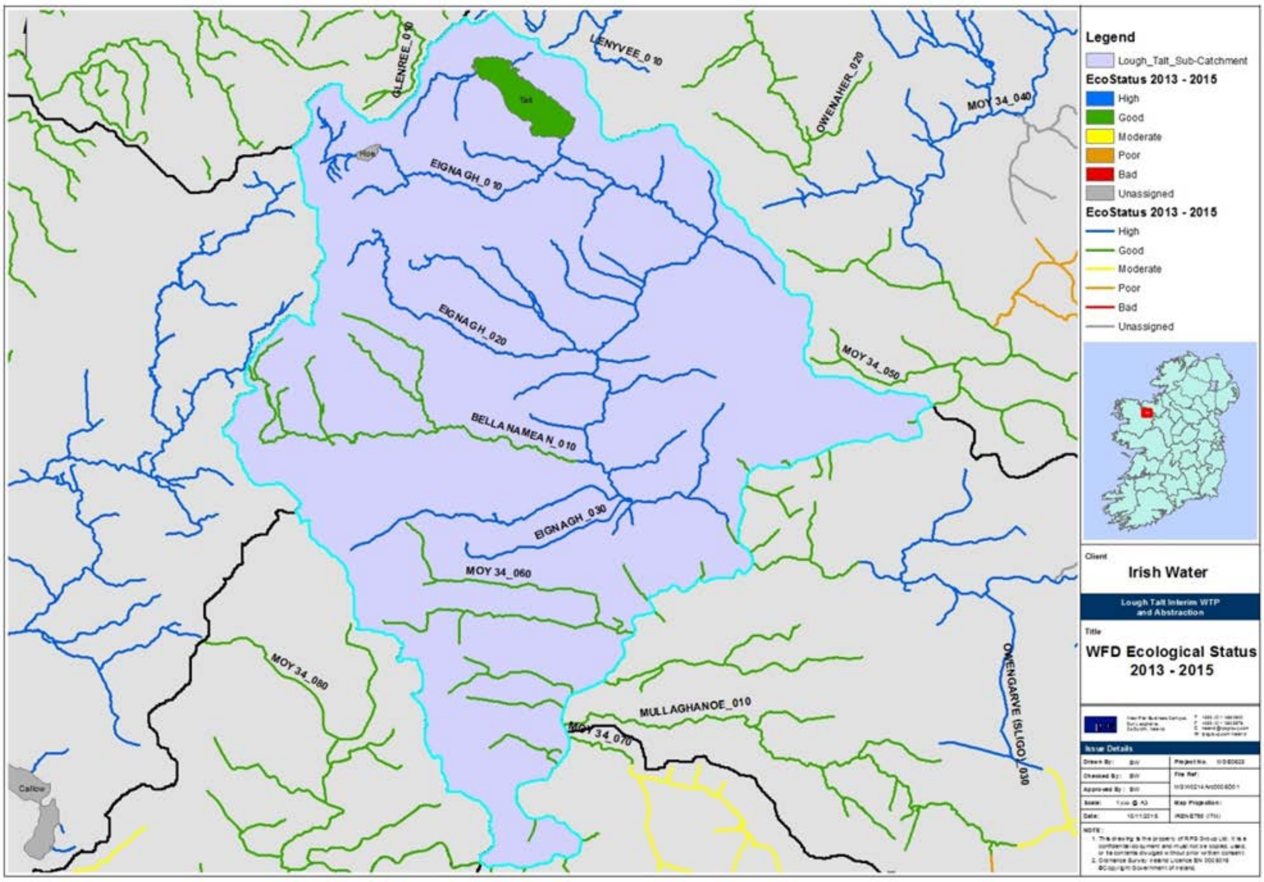


Figure 5-2: Lough Talt subcatchment WFD ecological status

[8] http://www.epa.ie/irelandsenvironment/stateoftheenvironmentreport/

Table 5.3: Physico-chemical results for Lough Talt for the years 2012 to 2015

Year	Min of Turbidity	Mean Turbidity ± SD	Max of Turbidity	Min Conductivity	Mean Conductivity @20C ± SD	Max Con @20C3	Min of Temperature	Mean temp ± SD	Max of Temperature2
2012	0.2	0.5 ± 0.3	1.1	149.0	165.5 ± 12.4	192.0	6.5	11.4 ± 3.8	16.4
2013	0.3	0.4 ± 0.1	0.4	140.0	161.9 ± 13.3	190.0	4.4	10.6 ± 5	21.1
2014	0.3	0.5 ± 0.3	1.2	161.0	166.3 ± 4.4	177.0	3.9	10 ± 4.1	15.9
2015	0.3	0.6 ± 0.3	1.3	151.0	161.7 ± 6.5	172.0	4.5	11.7 ± 4.3	19.5

Year	Min DO (%)	Mean Dissolved Oxygen (%) ± SD	Max DO (%)	Min Colour apparent	Mean Colour apparent ± SD	Max Colour apparent	Min Colour true	Average Colour true ± SD	Max Colour true
2012	94.0	100.3 ± 3.7	106.0	22.2	30.7 ± 4.2	37.3	18.6	26.6 ± 5.3	32.5
2013	94.0	100.2 ± 5.4	114.0	17.2	26.2 ± 4.8	33.6	15.6	21.9 ± 4.7	28.8
2014	85.0	97.3 ± 5.8	104.0	15.8	22.3 ± 3.7	28.5	12.4	17.6 ± 3.4	21.6
2015	89.0	97.2 ± 4	101.0	19.7	27.5 ± 3.6	32.4	16.3	22.8 ± 4.5	31.5

Year	Min Orthophosphate as PO4-P	Mean Orthophosphate as PO4-P	Max Orthophosphate as PO4-P	Min of Ammonia as N	Average of Ammonia as N ± SD	Max of Ammonia as N	Min of Chloride	Mean Chloride ± SD	Min of Chloride
2012	<0.01	<0.01	<0.01	0.007	0.029 ± 0.036	0.115	9.1	11.7 ± 2	9.1
2013	<0.01	<0.01	0.040	0.006	0.014 ± 0.007	0.029	10.3	11.3 ± 0.4	10.3
2014	<0.01	<0.01	0.015	0.011	0.031 ± 0.028	0.092	9.4	12.6 ± 1.1	9.4
2015	<0.01	<0.01	0.017	0.006	0.024 ± 0.02	0.053	13.4	14.1 ± 0.5	13.4

Year	Min of pH	Mean pH ± SD	Max of pH	Min DOC	Mean DOC ± SD	Max DOC	Min Total Hardness (Kone)	Mean Total Hardness (Kone) ± SD	Max Total Hardness (Kone)	Min Alkalinity	Mean Alkalinity, total ± SD	Max Alkalinity
2012	7.6	7.9 ± 0.2	8.2	3.1	*	3.1	72.0	78 ± 5.7	91.5	63.0	70 ± 6.3	83.0
2013	6.9	7.7 ± 0.4	8.1	2.3	2.6 ± 0.2	3.2	72.1	77 ± 3.1	82.4	57.0	73.5 ± 9.2	83.0
2014	7.1	7.7 ± 0.4	8.2	2.1	2.9 ± 0.5	3.6	49.5	74.3 ± 8.7	82.4	65.0	70.9 ± 3.8	79.0
2015	7.5	7.8 ± 0.2	8.1	2.8	3.2 ± 0.5	4.4	69.5	72.9 ± 2.8	77.5	55.0	79.3 ± 17.2	112.0

5.1.2.3.2 Lough Talt and Eighnagh River

The EPA currently carries out biological monitoring (Q value assessments using macroinvertebrates) at three locations on the Lough Talt/Eighnagh River as part of the National Rivers Monitoring Programme. The catchment has a long history of good water quality as evident from **Table 5.4.** Since 1977, biological water quality along the Lough Talt/Eighnagh River has been 'Class A, Unpolluted' being rated Q4 (good status), Q4-5 (high status) or Q5 (high status). The nearest EPA station to Lough Talt is 1.2km downstream of the lake but monitoring has not taken place at this location since 1993 when it was rated Q4-5 (high status). At the bridge 1.75km downstream of Lough Talt, monitoring has taken place every three years and between 2001 and 2013, water quality has consistently been rated Q5/Q4-5 (high status). Further downstream at Aclare and at the bridge upstream of the River Moy confluence, water quality was rated Q4-5 (high status) in 2013.

The Bellanamean River which joins the Eighnagh River downstream of Aclare is monitored at two locations. Biological water quality at the Bridge 1.5km north-east of Lough Naskea was rated Q4-5 (high status) and the Bridge upstream of the Eighnagh river was rated Q4 (good status) in 2013 and 2015 respectively.

The EPA carries out physico-chemical analysis of water samples from the Lough Talt/Eighnagh River as part of the National Rivers Monitoring Programme. General physico-chemical parameters are assessed on a pass / fail basis and include the analysis of generic determinants such as temperature, dissolved oxygen, BOD, conductivity, hardness, phosphorus, nitrogen, pH and alkalinity. Results for the period 2013 - 2015 indicate that the Eighnagh River passes all standards set for the parameters analysed.

Table 5.4: Biological Water Quality Results for the Eighnagh River

Station No.	Station location	'77	'79	'81	'86	'89	'93	'95	'98	'01	'04	'07	'10	'13	16
34E010080	Br 1.2 km d/s L. Talt	-	-	-	-	-	4-5	-	-	-	-	-	-	-	
34E010100	Bridge 1.75 km d/s Lough Talt	-	-	5	5	5	5	4-5	4-5	5	5	5	5	4-5	5
34E010200	Bridge in Aclare	-	4-5	5	4-5	4-5	4-5	4	4	4-5	5	-	4-5	4-5	4-5
34E010300	Br u/s Moy River at Cloongoonagh	5	-	4-5	5	4-5	4-5	4	4-5	4	4-5	4-5	4-5	4-5	4-5

5.1.2.4 Biological Water Quality Results

5.1.2.4.1 Field Survey work

Ecofact Environmental Consultants carried out biological sampling of Lough Talt and of the study area during September 2010. It must be noted that the biological indices used below were designed for rivers and are therefore not ideally suited for application to lacustrine habitats such as Lough Talt. However, the invertebrate groups in lacustrine habitats are influenced by organic pollution in a similar way as rivers so the scheme can be used for generally looking at results. **Table 5.5** and **Figure 5.3** present the locations of sampling sites for the 2010 assessment.

Table 5.5: Location of Sampling Sites and Work Completed at each Site during September 2010 aquatic ecological survey

Site Location	NOS Grid reference	Work completed					
		Biological sampling	Crayfish survey	Substrate survey	River corridor survey	Aquatic flora	Lamprey survey
L1: Lough Talt - south shore adjacent to outfall	G40341, 14503	✓	✓	✓		✓	✓
L2: Lough Talt - south west shore	G39939, 14550	✓	✓	✓		✓	✓
L3: Lough Talt - west shore	G39725, 14794	✓	✓	✓		✓	✓
L4: Lough Talt - north east shore	G39454, 15686	✓	✓	✓		✓	✓
R1: Eighnagh River ca. 1.8km downstream of lake	G41443, 13670	✓			✓	✓	✓
R2: Eighnagh River ca. 1.2km downstream of lake	G40952, 13940		✓		✓	✓	✓
R3: Eighnagh River ca. 500m downstream of lake	G40410, 141852		✓		✓	✓	✓
R4: Eighnagh River ca. 300m downstream of lake	G40220, 14278	✓	✓		✓	✓	✓
R5: Eighnagh River ca. 50m downstream of lake	G40325, 14461	✓	✓		✓	✓	✓
R6: Tawnyany Stream , ca. 500m upstream of lake	G38492, 15503		✓			✓	✓

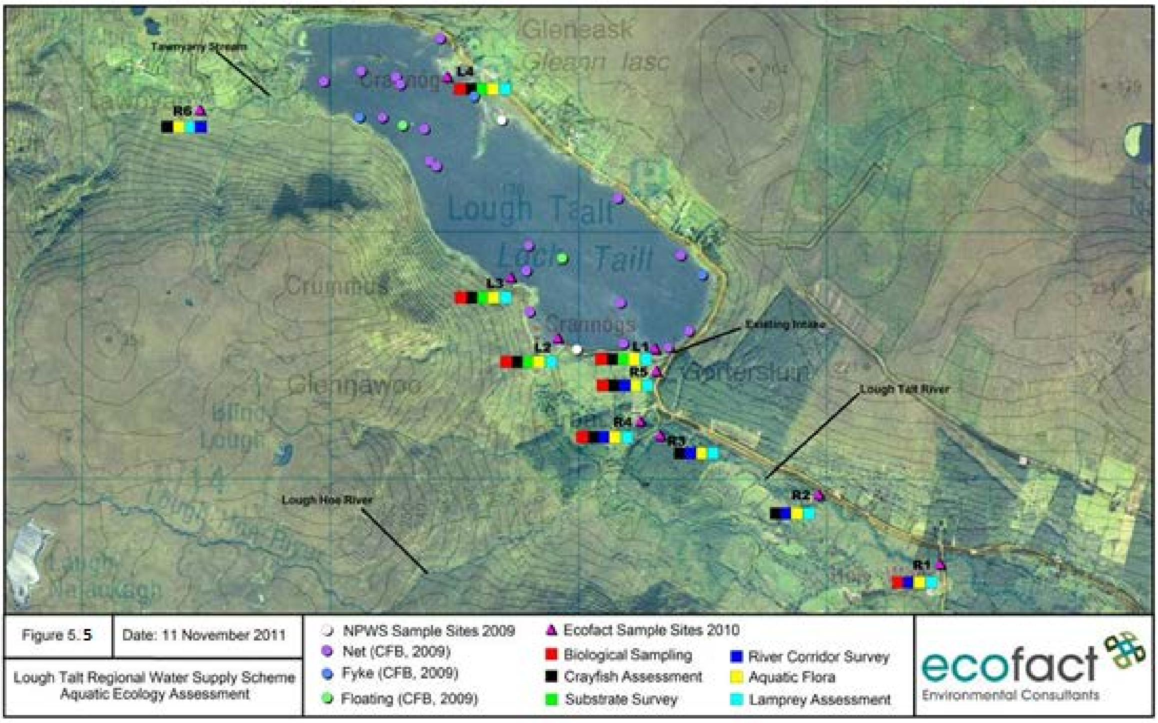


Figure 5-3: Map of Sampling Sites in the Eighnagh River Catchment

In **Table 5.6** the results of the biological water quality assessment for the sites surveyed in the study area is provided. **Table 5.7** gives the results of the on-site chemical water quality results. Dissolved oxygen concentrations in the Eighnagh River were close to 100% at all sites which is indicative of good water quality. The water quality results for each site are discussed separately below under Lough Talt and the Eighnagh River.

Table 5.6: Biological Water Quality Assessment of the Study Sites on Lough Talt and the Eighnagh River

	R1	R4	R5	L1	L2	L3	L4
Family diversity	16	19	11	10	11	12	11
Quality class	A	A	A	N/A	N/A	N/A	N/A
Quality status	Unpolluted	Unpolluted	Unpollute d	N/A	N/A	N/A	N/A
Q-rating	5	4-5	4	N/A	N/A	N/A	N/A
WFD status	High	High	Good	N/A	N/A	N/A	N/A
BMWP score	132.6	155	79.3	47.4	48.8	52.3	62.7
BMWP category	Very good	Very good	Good	Moderate	Moderate	Moderate	Moderate
BMWP interpretation	Unpolluted, unimpacted	Unpolluted, unimpacted	Clean, slightly impacted	Moderately impacted	Moderately impacted	Moderately impacted	Moderately impacted
ASPT	8.3	7.8	7.9	6.8	5.4	5.8	6.3

WFD=Water Framework Directive, BMWP=Biological Monitoring Working Party, ASPT=Average Score Per Taxon.

Table 5.7: Results of the On-site Chemical Water Quality Results September 2010

	R1	R4	R5	L1	L2	L3	L4
Temperature (^oC)	11.6	13.4	14	13.9	13.8	13.7	13.6
Dissolved Oxygen (%)	96	96.5	89	85.1	94.5	93.4	87
Dissolved Oxygen (mg O_2l^{-1})	10.5	10.02	9.29	8.7	9.68	9.59	9.11
Conductivity (µS cm^{-1})	190.3	189.1	188.2	186.6	184.2	187.8	190.7

5.1.2.4.2 Biological Water Quality Results for Lough Talt

Sampling for macroinvertebrates was carried out at four locations on the shore of Lough Talt. Using EPA pollution indicator macroinvertebrate groups, it was found that Group 'A' pollution sensitive taxa accounted for between 4% and 7% of the macroinvertebrate composition at the four sites examined on the lake. Although the presence of filamentous algae on substrates indicated some eutrophication/enrichment of the lake, the presence of larvae of the pollution sensitive mayfly *Ephemera danica* and *Heptagenia sulphurea* was indicative of generally good water quality. In general, the macroinvertebrate assemblage along the Lough Talt shoreline was considered to be diverse and indicative of good water quality and stable water levels. The bulk of the assemblage comprised Group 'C' pollution tolerant taxa and percentages at the surveyed sites ranged from 66% to 74%. This would be expected in a lacustrine environment.

The Biological Monitoring Working Party (BMWP) scores attained for the sites were largely similar at Site L1 (47.4), L2 (48.8) and L3 (52.3). The corresponding Average Score per Taxon (ASPT) at these sites were 6.8, 5.4 and 5.8. Site L4 scored higher on the BMWP index (62.7) and the ASPT at this site was 6.3. The index at all sites therefore puts the lake in the 'Moderate' category and interpreted as 'Moderately impacted', although the results here must be interpreted with caution as this is a scheme for rivers. The ASPT scores were generally indicative of good water quality; all sites with the exception of L1 scoring greater than 5.5. The main difference between the BMWP score and the ASPT is that the latter does not depend on the family richness. Taking the four sites investigated on the lake and grouping the macroinvertebrates recorded yield a BMWP score of 100.4 and an ASPT of 5.9. This BMWP score is indicative of 'Very good' water quality.

However, it must be noted that the level of siltation at all sites investigated was deemed considerable. Some of this silt may have originated from a landslide that took place on the hill to the west of Lough Talt during early September 2010. Filamentous algae were also recorded growing on the hard substrata at all sites examined. This suggests pollution in the form of enrichment. Dissolved oxygen concentrations in the lake were taken at the each site and were found to be within the range 85.1%- 94.5%.

5.1.2.4.3 Biological Water Quality Results for Eighnagh Talt River

Table 5.8 gives the macroinvertebrate taxa recorded at each site in terms of their pollution sensitivity based on EPA methods. It can be seen that the relative abundance of pollution sensitive taxa is greatest at Site R1 (35.9%) approximately 1.8km downstream of Lough Talt. The relative abundance of this pollution sensitivity group decreases however towards Lough Talt. At Site R3 which is approximately 300 meters from Lough Talt, the fraction of Group 'A' indicators was 28.6%. A further decrease of Group 'A' indicators was recorded at the uppermost site (Site R4) approximately 50 meters downstream of the lake, accounting for only 5.3% of the assemblage. Group 'D' very tolerant indicators constituted an insignificant proportion of the macroinvertebrate communities at each of the Eighnagh River sites. It is noted that most tolerant (Group 'E') indicators were not recorded at the sites examined in the Eighnagh River.

Table 5.8: Classification of Macroinvertebrate Taxa Recorded at each Site in terms of their Pollution Sensitivity (EPA Methods)

Pollution indicator group	R1		R4		R5		L1		L2		L3		L4	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Group A (Most sensitive)	94	36	57	29	5	5	4	7	3	4.8	2	3.6	4	7.4
Group B (Less Sensitive)	24	9	7	4	6	6.4	15	26	5	8.1	12	22	7	13
Group C (Tolerant)	141	54	133	67	83	88	37	66	45	73	33	60	40	74
Group D (Very Tolerant)	3	1	2	1	0		0		6	10	8	15	0	
Group E (Most Tolerant)	0	0	0		0		0	0	3	5	0		3	6
Total	262	100	**199**	**100**	**94**	**100**	**56**	**100**	**62**	**100**	**55**	**100**	**54**	**100**

Site R1: A total of 6 'Group A' pollution sensitive species were recorded with one taxon being common. The dissolved oxygen was indicative of good water quality at 96% saturation. Furthermore, the substrate was clean and free of silt or algal growths. This site is therefore rated 'Class A, Unpolluted (Q5)' using criteria in the EPA Q-value system. This rating corresponds to *high status*. The

Biological Monitoring Working Party (BMWP) score for this site was exceptionally high at 132.6 considering that a score of 100 or greater indicates 'Very good' water quality. Correspondingly, the Average Score Per Taxon was unusually high at 8.3, again indicative of unpolluted conditions.

Site R4: The macroinvertebrate assemblage at this site comprised mostly 'Group C' pollution tolerant taxa. This site however contained a rich macroinvertebrate community and included a pollution sensitive mayfly larva which was common. Four additional pollution sensitive stonefly taxa were recorded at this site. The dissolved oxygen concentration was 96.5%. It was noted that the substrate was lightly silted but filamentous algae was not seen in the stream. Using the EPA freshwater biological monitoring system, this site was rated 'Class A, Unpolluted (Q4-5)', equivalent to *high status*. Conductivity was 189.1µS/cm. The BMWP score at this site was 155, owing to the rich macroinvertebrate richness (N=20). This score and the ASPT of 7.8 are indicative of very good water quality.

Site R5: This site comprised mainly pollution tolerant taxa but two pollution sensitive stonefly species were recorded in small numbers. It is noted that there was difficulty in sampling macroinvertebrates at this site due to the rigid nature of the substrate. This part of the river appeared clean and un-silted. This part of the Eighnagh River was rated 'Class A, Unpolluted (Q4)' corresponding to *good status*. The BMWP score of 79.3 implies that water quality at this location is 'Good' but slightly impacted. The suboptimal conditions for macroinvertebrates at this location could be responsible for the decrease in family richness and consequently the BMWP score. The ASPT of 7.9 however is significantly greater than the score of 5.5, above which water quality is considered to be good.

5.1.2.4.4 Biological Water Quality Results – 2016

An updated white-clawed crayfish survey assessment as well as an account of other aquatic macroinvertebrates and littoral aquatic flora was undertaken by Ecofact Environmental Consultants in early October 2016.

Four sites on Lough Talt were surveyed during October 2016. The site locations are listed in **Table 5.9** and are shown in **Figure 5-4**. These sites correspond to the lake sites previously surveyed in 2010 (Ecofact, 2010).

Table 5.9: Location of the sites examined on Lough Talt during October 2016

Site	Aspect	NOS Grid Reference
L1	South shore adjacent to outfall	G4034, 1450
L2	South-west shore	G3993, 1455
L3	West shore	G3972, 1479
L4	North-east shore	G3945, 1568

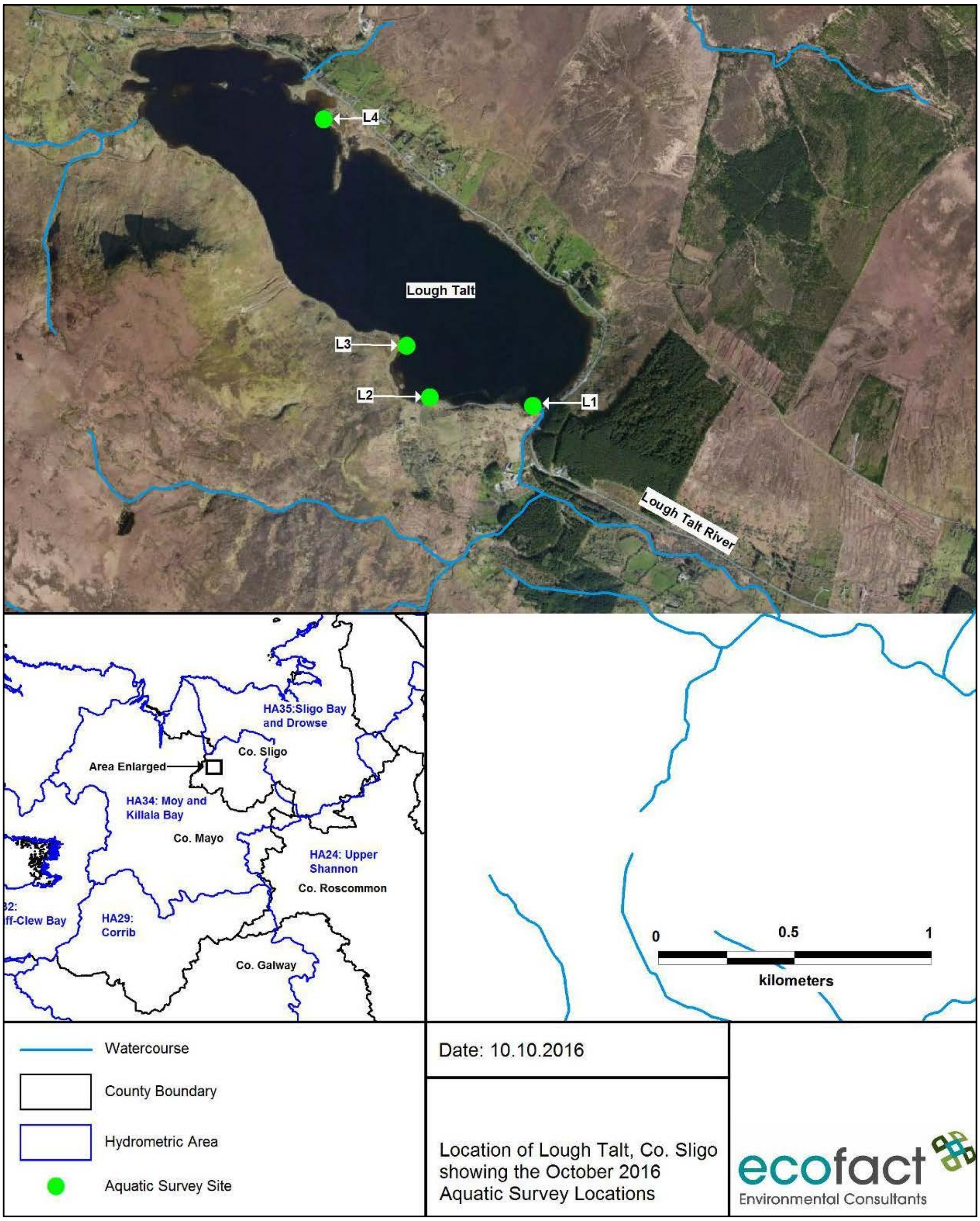


Figure 5-4: Location of the sites surveyed on Lough Talt during October 2016

5.1.3 Macroinvertebrates

White-clawed Crayfish were collected by hand searching in 100 potential refuges from the littoral zone of the four sites around the lake during early-October 2016. The findings of the survey are provided in **Section 5.3.1.1.** Lough Talt supports a wide range of aquatic insects as depicted by the results. The species recorded at each location are a function of the habitats present and apparently good water quality. Collectively, three species of pollution sensitive mayfly were recorded during the surveys: these were larvae of *Heptagenia sulphurea, Heptagenia lateralis* and *Ephemera danica*.

Mayfly larvae of *Caenis rivulorum* and *Centropitulum luteolum* were also recorded. White-clawed Crayfish were recorded at all locations.

Only one species of cased caddisfly was recorded: *Ceraclea nigronervosa.* Cases of *Hydroptilidae* were recorded at Site L3 but the larvae had recently hatched out. The caseless Trichopteran community was limited to larvae of *Polycentropus kingi* and *Plectronemia geniculata.*

Table 5.10 gives a biological water quality assessment of the study sites on Lough Talt. A broad range of macroinvertebrates are supported by the lake - a total of 24 families were recorded collectively across the four sites. Macroinvertebrate family richness ranged from 9 at Site L1 to 17 at Site L4. Greater macroinvertebrate diversity is associated with better water quality. The Biological Monitoring Working Party (BMWP) scores ranged from 57.6 at Site L2 (interpreted as moderately impacted) to 89.6 at L4 (interpreted as clean but slightly impacted). It is noted however that this biotic index was designed for flowing waters (fluvial/river habitats) so these interpretations are for demonstration and comparison with the 2010 results only.

Table 5.10: Biological water quality assessment of the study sites on Lough Talt.

Biotic index	Site			
	L1	L2	L3	L4
No. of different families	9	9	14	17
BMWP score	67.2	57.6	76.3	89.6
BMWP category	Moderate	Moderate	Good	Good
BMWP interpretation	Moderately impacted	Moderately impacted	Clean but slightly impacted	Clean but slightly impacted
ASPT	6.7	6.4	5.9	5.3

5.1.4 Aquatic Plants

The aquatic flora recorded at each site is given in **Table 5.11** below. Canadian waterweed *Elodea canadensis*, Alternate Water-milfoil *Myriophyllum alterniflorum,* Stonewort *Nitella sp.,* Shoreweed *Littorella uniflora* and Filamentous Algae were recorded at Lough Talt with only Filamentous Algae occurring at each of the four sample sites.

Table 5.11: Aquatic flora recorded at each site surveyed in Lough Talt in October 2016

Site	L1	L2	L3	L4
Canadian Waterweed *Elodea canadensis*	*R*			
Alternative Water-milfoil *Myriophyllum alterniflorum*		*R*		
Stonewort *Nitella sp.*		*R*	*R*	*F*
Shoreweed *Littorella uniflora*				*A*
Filamentous Algae	*A*	*D*	*A*	*O*
Freshwater Sponge *Spongilla lacustris*	*R*			

*DAFOR Scale: D=Dominant; A=Abundant; F=Frequent; O=Occasional; R=Rare.

Canadian waterweed *Elodea canadensis* is a non-native, invasive aquatic plant that is usually completely submerged under water. Dense growth of this species can replace native aquatic plant species and reduce biodiversity in lakes and ponds. It is a shallow rooted plant found in mesotrophic and eutrophic still and slow flowing waters. It prefers high levels of silt but can tolerate a range of mineral conditions and can persist in anaerobic substrates. Canadian waterweed was only present at Site 1. The substrate at this site consisted mainly of rock, abundant in filamentous algae, therefore there was little silt habitat present for plant roots. Only one strand was found at this site, leading to the assumption that this species is rare in Lough Talt.

Alternate Water-milfoil *Myriophyllum alterniflorum* is a native aquatic plant usually found in mesotrophic or oligotrophic waters. Site 2 mainly consisted of rocky substrates but in a small area of silt it was found in a cluster on the lake bed, therefore it was a rare occurrence in the surveyed area. Stonewort *Nitella sp.* was found at Sites 2, 3, and 4. Sites 2 and 3 mainly consisted of rocky substrates where *Nitella sp*. was rare but it was recorded on the lake bed in between rocks. This species was frequent at Site 4, likely due to the fact that the substrate comprised of more cobble and sandy areas suitable for plant roots. Along the shore at Site 4 there was a considerable amount of dried Stonewort that had been washed up. *Nitella sp.* is usually found growing in shallow to deep waters or soft water or acid lakes or bogs. It frequently forms a thick carpet or grows in clumps along the bottom. Freshwater Sponge *Spongilla lacustris* was recorded on a rock at Site 1, and not seen in any other area surveyed. The shoreweed *Littorella uniflora* was found to be frequent at site 4. The substrate at this site consisted mainly of cobble, with areas of sand suitable for plant roots. Filamentous Algae was the dominating flora found at Lough Talt. Sites 1, 2 and 3 consisted of some rocky substrates that were covered in filamentous algae.

Based on the plant species abundance and assemblage, fish communities and water chemistry within Lough Talt, this waterbody has affinities with the Oligo-mesotrophic lake habitat [3130], based on the updated interpretation of this habitat (O'Connor, 2015); however, lakes affected by water level fluctuations should not be included within this Annex I habitat classification (O'Connor, 2015).

5.1.5 Flooding

A search of the Office of Public Works National Flood Hazard Mapping website, www.floodmaps.ie, was performed to obtain information on flooding history in the vicinity of the Lough Talt RWSS WTP. The results indicate that a number of flood events have been recorded along the south-east side of Lough Talt, upstream of the proposed WTP upgrade site. There are no recorded flood events along the Eighnagh River within proximity to the proposed WTP upgrade site. **Figure 5-5** shows the location of these floods relative to the proposed Lough Talt Lough Talt RWSS WTP.

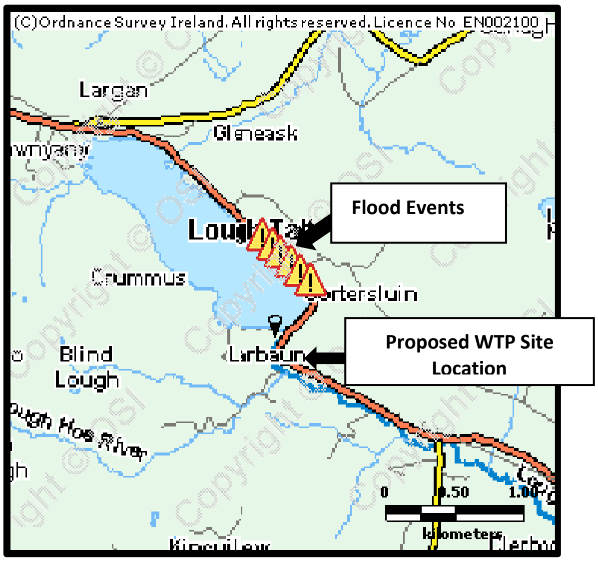


Figure 5-5: Location of Flood Events at Lough Talt

Details of these flood events have been recorded at a Council meeting with the Area Engineer for the Tubbercurry area on the 8th December 2005 as follows:

- "Road flooding in vicinity of Lough Talt during heavy rain as a result of runoff coming off high ground and flooding road. – recurring Flood ID 4906"
- "Road flooding in vicinity of Lough Talt during heavy rain as a result of runoff coming off high ground and flooding road. – recurring Flood ID 4907 "
- "Road flooding in vicinity of Lough Talt during heavy rain as a result of runoff coming off high ground and flooding road. – recurring Flood ID 4908"

There are no subsequent records for flood events for Lough Talt or the Eighnagh River.

5.1.6 Soils, Geology & Hydrogeology

Subsoils within and surrounding the Lough Talt RWSS WTP upgrade support till derived from metamorphic rocks (TMp) while the eastern boundary of the site is fringed by scree (See **Figure 5-6**). Outside of the immediate area of the proposed WTP upgrade site, the landscape is dominated by Blanket Peat (BkPt) with discrete areas of TMp, Rock and Scree scattered throughout the area.

The Geological Survey of Ireland (GSI) website was consulted for available geological/hydrological information. In the immediate vicinity of the proposed WTP upgrade, the bedrock geology is classified as schist, aluminous schist, and pebble beds. This bedrock within and bordering the proposed WTP upgrade is classified as a Poor Aquifer (PI), which is generally unproductive except for local zones (See **Figure 5-7**). Granites and other igneous rocks (GII) underlie an area to the west of the lake, and this is also considered to be a poor aquifer.

The GSI Groundwater vulnerability mapping for the area classifies the groundwater as Extreme (E). Vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease at which groundwater may be contaminated by human activities.

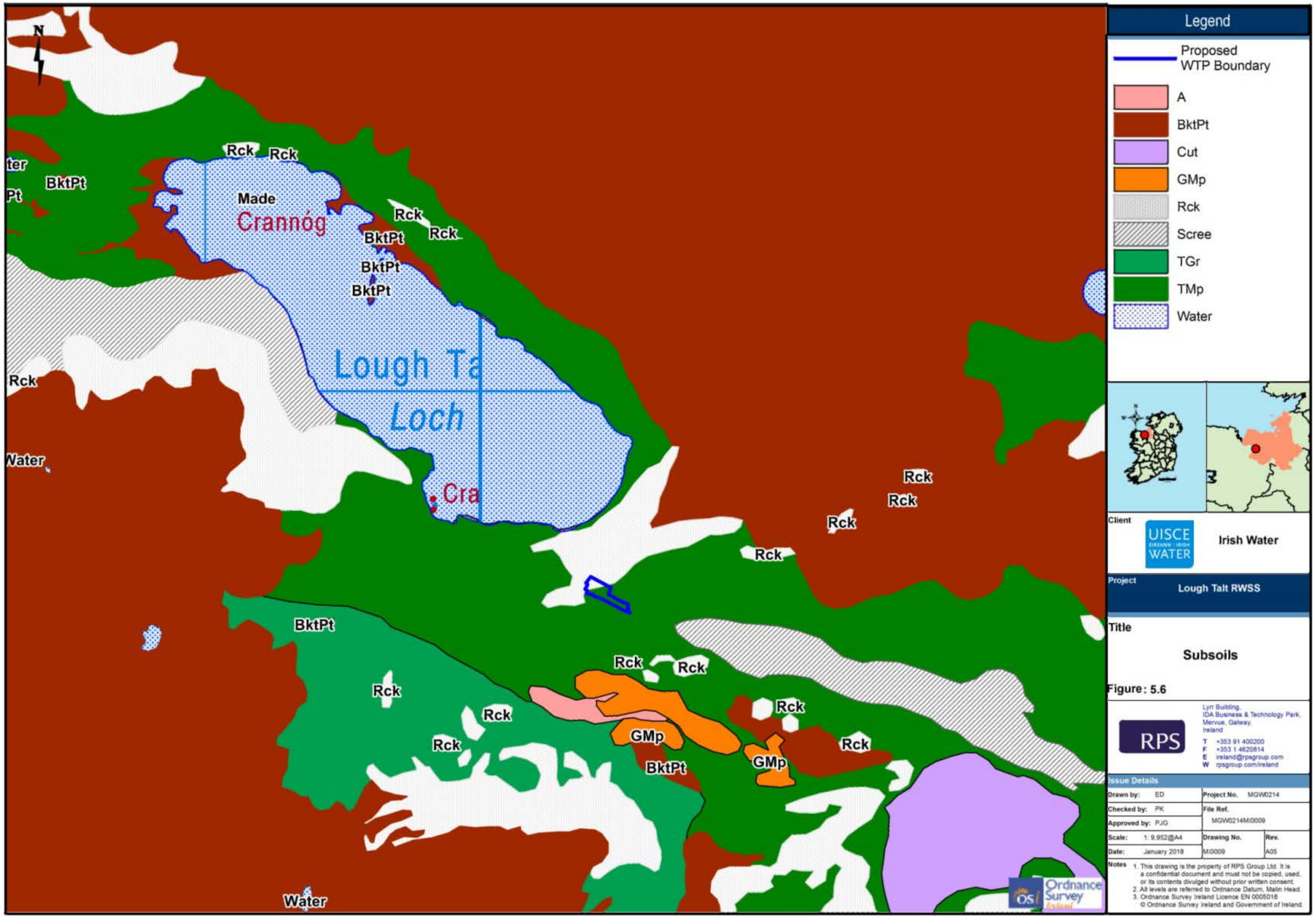


Figure 5-6: Subsoils within and fringing the Lough Talt WTP upgrade

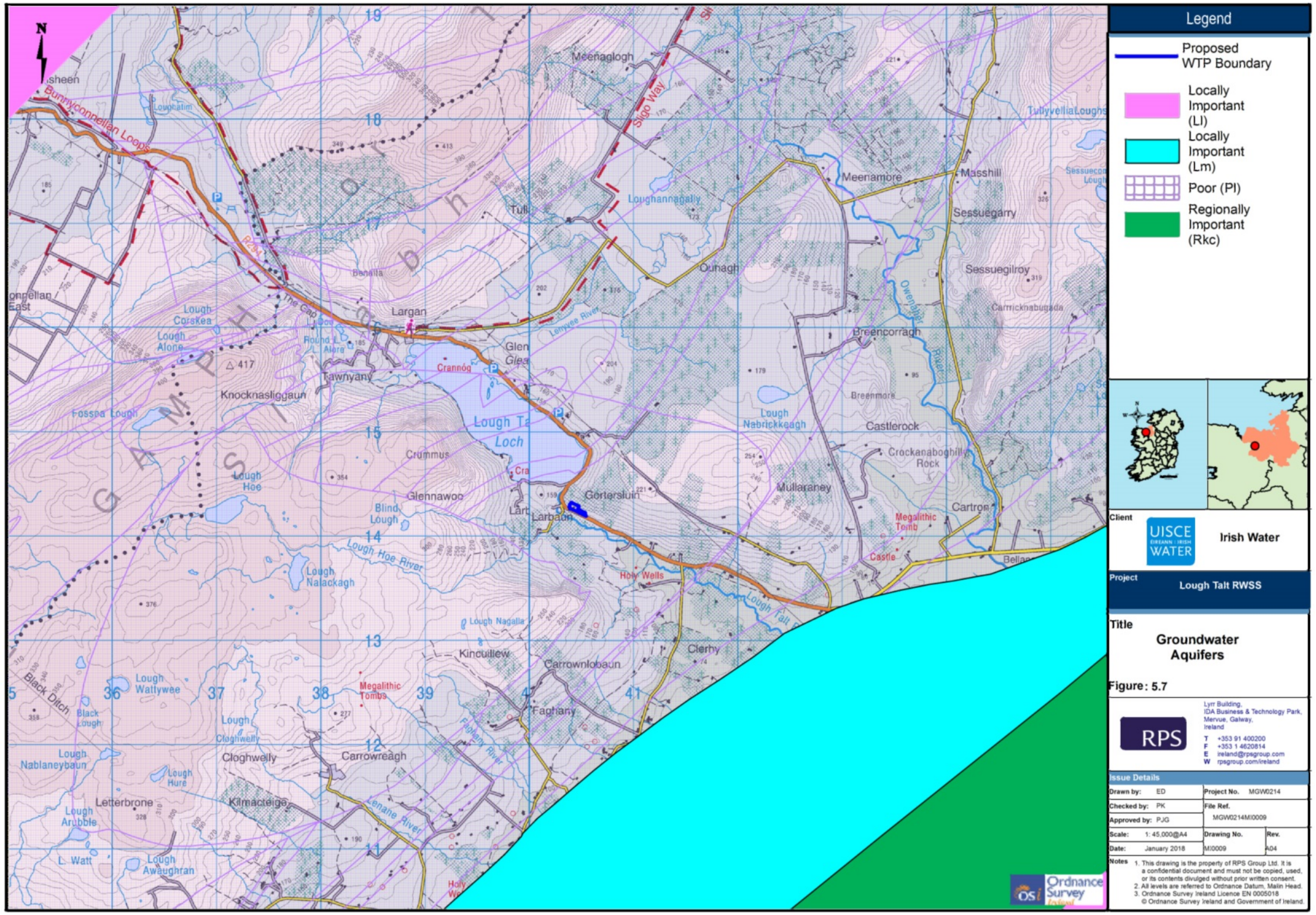


Figure 5-7: Groundwater Aquifers within the proposed study area and environs

The EPA online mapviewer (http://gis.epa.ie/Envision), and more recently the EPA Catchments website (https://www.catchments.ie/), have identified the groundwater body underlying the Lough Talt RWSS WTP upgrade is the Foxford Groundwater body. **Table 5.12** summarises the status attained under the WFD risk score for this Groundwater Body.

Table 5.12: Foxford Groundwater Body - Status as set out in the EPA online mapviewer[9]

Element	Rating for the Foxford Groundwater Body
Groundwater WFD Status 2010 - 2015	Good
WFD Groundwater Waterbody Risk Score	Expected to Achieve Good Status

5.2 EUROPEAN SITES

5.2.1 Qualifying Features of the European Sites

The Qualifying Features of SACs and the Special Conservation Interests of SPAs include the Habitats listed in Annex I and the Species listed in Annex II of the Habitats Directive, and Annex I of the Birds Directive, for which European sites must be designated by member states.

On the Natura 2000 Standard Data Form prepared by the NPWS for each European site the ecological and species information is provided. For habitats, details of the Percentage Cover and Representativity are provided. The percentage cover for each habitat is described and the degree of Representativity gives a measure of 'how typical' a habitat type is. Representativity is ranked on a scale from A to D as follows; A - Excellent, B -Good, C – Significant and D - Non-significant.

For species, the population significance is based on the relative size or density of the population in the site with that of the national population. Population Significance (p) is ranked on a scale from A to D as follows; A - 100>=p>15%, B - 15>=p>2%, C - 2>=p>0% and D - Non-significant population. The qualifying habitats and species for the European are provided below.

The main threats and impacts are also provided for each qualifying interest or special conservation interest of the European sites, which are listed in the Natura 2000 data forms (2014-2019) for the sites and in the NPWS 2013 Article 17 report '*The Status of EU Protected Habitats and Species in Ireland*'.

5.2.1.1 Lough Hoe Bog SAC

Lough Hoe Bog SAC is an extensive area of primarily highland blanket bog, with limited areas of montane blanket bog and loughs. The site covers an area of 3189 ha and is situated in the Ox Mountains in Counties Sligo and Mayo. The site supports blanket bog and oligotrophic (nutrient poor) lakes, which are both listed in Annex I of the EU Habitats Directive and White-clawed Crayfish and *Vertigo geyeri*, a land snail, which are both listed on Annex II of the EU Habitats Directive. The SAC runs north-east to south-west on a broad, silica-rich, granite mountain ridge. The northern

[9] Data sourced from the EPA online mapviewer, accessed 19/02/2015 and EPA Catchments website accessed on 07/11/2015.

margin of the site encompasses Lough Talt, which is located 13km from Tobercurry and 17km from Ballina.

The qualifying habitats and species found within Lough Hoe Bog SAC are set out in **Table 5.13** for habitats (habitat types highlighted in **bold** area priority **Annex I habitats**) and **Table 5.14** for species. The main threats and pressures on the site are set out **Table 5.15** below.

Table 5.13: Lough Hoe Bog SAC Qualifying Habitats (Site Code 000633)

Habitat code	Habitat name (SAC Qualifying Feature)	Area (ha)	% Cover (approx.)	Representativity	Conservation Status[10]
7130	**Blanket Bog (* if active)**	**1221.86**	**38**	**C**	Overall Assessment – Bad – U2 Overall Trend– declining (-)
3110	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)	128.62	4	B	Overall Assessment – Unfavourable, Bad, Declining Overall Trend– declining (-)

Table 5.14: Lough Hoe Bog SAC Qualifying Species (Site Code 000633)

Species code	Species name	Population Significance	Conservation Status[11]
1013	Geyer's Whorl Snail *(Vertigo geyeri)*	B	Overall Assessment – Unfavourable Inadequate – U1 Overall Trend– declining (-)
1092	White-clawed Crayfish *(Austropotamobius pallipes)*	C	Overall Assessment – Unfavourable -Inadequate – U1 Overall Trend – stable (=)

Table 5.15: Negative threats, pressures and activities with high effect on Lough Hoe Bog SAC

Rank / Magnitude[12]	Threat / Pressure[13]	Inside (i) / Outside (o) SAC bounds[14]
H	Mechanical removal of peat (C01.03.02)	i
M	Grazing (A04)	i
H	Forest planting on open ground (B01)	i
H	Wind energy production (C03.03)	i
H	Burning down (J01.01)	i

[10] NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Habitat Assessments Volume 2. Version 1.1. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
[11] NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Species Assessments Volume 3. Version 1.0. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
[12] L = Low, M = Medium, H = High – Source Natura 2000 Standard Data Form (2015)
[13] Threat / pressure codes follow EU reference and threat list codes for Natura 2000 sites – Source Natura 2000 Standard Data Form (2015)
[14] Threat source from within or outside SAC bounds - Source Natura 2000 Standard Data Form (2015)

5.2.1.2 River Moy SAC

This site comprises almost the entire freshwater element of the River Moy and its tributaries including both Loughs Conn and Cullin. The system drains a catchment area of 805 sq. km. Most of the site is in Co. Mayo, though parts are in west Sligo and north Roscommon. Apart from the Moy itself, other rivers included within the site are the Deel, Bar Deela, Castlehill, Addergoole, Clydagh and Manulla on the west side, and the Glenree, Yellow, Strade, Gweestion, Trimogue, Sonnagh, Mullaghanoe, Owengarve, Eighnagh and Owenaher on the east side. The underlying geology is Carboniferous Limestone for the most part, though Carboniferous Sandstone is present at the extreme west of the site, with Dalradian quartzites and schists at the south-west. Some of the tributaries at the east, the south of Lough Conn and all of Lough Cullin are underlain by granite (NPWS, 2014)[15].

The site is also important for the presence of four other species listed on Annex II of the EU Habitats Directive including Sea Lamprey, Brook Lamprey, Otter and White-clawed Crayfish. Annex I habitats for which the site is designated include alluvial woodland, oak woodland, raised bogs and alkaline fen.

The qualifying interests of the River Moy SAC are set out below in **Table 5.16** for habitats (habitat types highlighted in **bold** area priority **Annex I habitats**) and **Table 5.17** for species. Their main threats and impacts are shown on **Table 5.18**.

Table 5.16: Qualifying Habitats of the River Moy SAC

Habitat Code	Habitat name (SAC Qualifying Feature)	% Cover ha (approx.)	Representativity	Conservation Status[16]
7110	**Active raised bogs**	45.25	B	Overall Assessment – Bad – U2 Overall Trend– declining (-)
7120	Degraded raised bogs still capable of natural regeneration	82.12	B	Overall Assessment – Bad – U2 Overall Trend– declining (-)
7150	Depressions on peat substrates of the Rhynchosporion	2.51	B	Overall Assessment – Inadequate – U1 Overall Trend– Favourable
7230	Alkaline fens	153.96	A	Overall Assessment – Unfavourable - Bad – U2 Overall Trend– Unknown (x)
91A0	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	153.96	A	Overall Assessment – Unfavourable Bad – U2 Overall Trend– Improving (+)
91E0	**Alluvial forests with Alnus glutinosa and Fraxinus excelsior (*Alno-Padion, Alnion incanae, Salicion albae*)**	153.96	B	Overall Assessment – Unfavourable Bad – U2 Overall Trend– Improving (+)

[15] NPWS (2014) Site synopsis for River Moy SAC: Version date: 6.01.2014
[16] NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Habitat Assessments Volume 2. Version 1.1. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland

Table 5.17: Qualifying Species of the River Moy SAC

Species Code	Species Name	Population Significance	Conservation Status[17]
1092	*Austropotamobius pallipes* (White-clawed Crayfish)	C	Overall Assessment – Unfavourable Inadequate – U1 Overall Trend– stable (=)
1095	*Petromyzon marinus* (Sea Lamprey)	C	Overall Assessment – Bad – U2 Overall Trend– stable (=)
1096	*Lampetra planeri* (Brook Lamprey)	C	Overall Assessment – Favourable – FV Overall Trend– stable (=)
1106	*Salmo salar* (Salmon)	C	Overall Assessment – Unfavourable Inadequate – U1 Overall Trend– stable (=)
1355	*Lutra lutra* (Otter)	C	Overall Assessment – Favourable – FV Overall Trend– stable (=)

Table 5.18: Threats, pressures and impact activities to River Moy SAC

European Site	Threat Code	Threat Type[18]	Rank	i (inside)/ o(outside)/b (both)[19]
River Moy SAC	B05	Use of fertilizers (forestry)	H	b
	H01.05	Diffuse pollution to surface waters due to agricultural and forestry activities	H	b
	D04.02	Airports, flightpaths	M	b
	C01.03	Peat extraction	M	b
	I01	Invasive non-native species	H	b
	B01	Forest planting on open ground	H	b
	A02.01	Agricultural intensification	H	b

5.2.2 Conservation Objectives of European Sites

The integrity of a European site (referred to in Article 6.3 of the EU Habitats Directive) is determined based on the conservation status of the qualifying features of the SAC as set out above.

European and national legislation places a collective obligation on Ireland and its citizens to maintain at favourable conservation status areas designated as SAC and SPA. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

[17] NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Species Assessments Volume 3. Version 1.0. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland
[18] Threat code follows reference list provided on threats, pressures and activities for European Sites
[19] Threat occurs inside (i), outside (o) or both inside and outside (b) of European site

Qualifying Interests (QIs) are Annex I habitats and Annex II species listed in the Habitats Directive for which an SAC has been designated and the Special Conservation Interests (SCIs) are the bird species and habitats for which the SPA has been designated. The conservation objectives for European sites are set out to ensure that the QIs/ SCIs of that site are maintained or restored to a favourable conservation condition. Maintenance of favourable conservation condition of habitats and species at a site level in turn contributes to maintaining or restoring favourable conservation status of habitats and species at a national level and ultimately at the Natura 2000 Network level.

In Ireland 'generic' conservation objectives have been prepared for all European Sites, while 'site specific' conservation objectives have been prepared for a number of individual European sites to take account of the specific QIs/ SCIs of that site. Both the generic and site specific conservation objectives aim to define favourable conservation condition for habitats and species at the site level.

Generic conservation objectives which have been developed by NPWS encompass the spirit of site specific conservation objectives in the context of maintaining and restoring favourable conservation condition as follows:

For SACs:

- '*To maintain or restore the favourable conservation condition of the Annex I habitats and/or Annex II species for which the SAC has been selected'.*

For SPAs:

- '*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for the SPA*'.

Favourable Conservation status of a habitat is achieved when:

- Its natural range, and area it covers within that range, are stable or increasing;
- The specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future; and
- The conservation status of its typical species is "favourable".

The favourable conservation status of a species is achieved when:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats,
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

A full listing of the conservation objectives and QIs/ SCIs for each European site, as well as the attributes and targets to maintain or restore the QIs/ SCIs to a favourable conservation condition, are available from the NPWS website www.npws.ie.

5.2.3 Conservation Objectives for Lough Hoe SAC

The site specific conservation objectives for the Lough Hoe SAC were published on August 31st 2017 and are available on the NPWS website at the following link: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000633.pdf.

5.2.4 Conservation Objectives for River Moy SAC

The site specific conservation objectives for the River Moy SAC are available on the NPWS website https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002298.pdf and were published on the 03rd August 2016. The overarching conservation objectives have been provided by the NPWS for this SAC.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected.

5.2.5 Assessment on Qualifying Interests of proximal European sites

The existing environment has been assessed for the presence/absence of the qualifying interests of Lough Hoe Bog SAC and the River Moy SAC and the findings are presented in **Section 5.1** and summarised in **Table 5.19**.

Table 5.19: QI Assessment on Qualifying Interests or Special Conservation Interests of proximal European sites

Qualifying Interest	Presence/Absence within site
Lough Hoe Bog SAC (000633) (Site Specific Conservation Objectives document published on 31/08/2017)	
[3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)	The site specific CO for Lough Hoe Bog provides the following in relation to the distribution of this Annex I habitat: *Lake habitat 3110 is likely to occur in larger upland lakes in the SAC, such as Loughs Hoe, Alone, Fossea and Nalackagh. The exact distribution of 3110 is unknown, as no specific information on lake vegetation is available. Habitat 3110 may co-occur with lake habitat 3160 in upland lakes, which is also likely to occur in smaller lakes and ponds. There are also calcareous influences- Lough Talt has marginal calcareous springs and may be dominated by lake habitat 3140 (n.b. 3140 and 3160 are not qualifying interests).* Lough Talt does not support 3110 habitat, as the plant assemblages, fish community and water chemistry supports affinities to the 3130 habitat as outlined in O'Connor (2015); however, lakes affected by water level fluctuations should not be included within the Annex I habitat classification (O'Connor, 2015). Loughs Hoe, Fossea and Nalackagh do support the 3110 habitat type and discharge to the Lough Hoe River and Lough Alone discharges to the Creengganalar River and are hydrologically isolated from Lough Talt and therefore the hydrological regime of these lakes is not influenced by the abstraction at Lough Talt or the construction, operation or decommissioning of the WTP. Further, the underlying groundwater body supports poor transmissivity meaning hydrogeological pathways and consequent impacts between Lough Talt and these waterbodies are unlikely to be significant. Therefore, this QI habitat will not be directly affected by the abstraction and is not considered further in this assessment
[7030] Blanket bogs (* if active bog)	Revegetated cutover bog, colonised by wet heath vegetation is found on the northern western shores of Lough Talt. From the NPWS habitat mapping for Lough Hoe Bog blanket bog intact blanket bog habitat is found on the top Crummus mountain to the west of lake. Blanket bogs are rain-fed (ombrotrophic) peatlands

Qualifying Interest	Presence/Absence within site
	where almost all inputs of water are derived from precipitation. Therefore, this QI habitat will not be directly or indirectly affected by the construction or operation of the WTP and is not considered any further in this assessment.
[1013] Geyer's Whorl Snail (*Vertigo geyeri*)	Fen habitats on the shores of Lough Talt support suitable habitat for V. *geyeri*. The species was first recorded at Lough Talt in 1992 and in subsequent surveys up until 2007. In 2008, *V. geyeri* were not found during that survey, nor have the species been found in subsequent surveys undertaken between 2010 and 2016. Therefore, this QI species will be considered further in this assessment.
[1092] White-clawed Crayfish (*Austropotamobius pallipes*)	Present. Numerous surveys have confirmed the presence of White-clawed Crayfish in Lough Talt. Therefore, this QI species will be considered further in this assessment.
River Moy SAC (002298) (Site Specific Conservation Objectives document published on the 03/08/2016)	
[1092] White-clawed Crayfish (*Austropotamobius pallipes*)	Present. Numerous surveys have confirmed the presence of White-clawed Crayfish in the River Moy SAC. Therefore, this QI species will be considered further in this assessment.
[1095] Sea Lamprey (*Petromyzon marinus*)	Remote. This Annex II species occurs within the tidal / freshwater interface confluence of the River Moy located > 15km downstream. This is an anadromous species migrating from coastal waters upstream to freshwater catchments to spawn. Therefore, this QI species will be considered further in this assessment.
[1096] Brook Lamprey (*Lampetra planeri*)	Present downstream. Therefore, this QI species will be considered further in this assessment.
[1106] Salmon (*Salmo salar*)	Present downstream. Therefore, this QI species will be considered further in this assessment.
[1355] Otter (*Lutra lutra*)	Present. Found throughout the River Moy system. Therefore, this QI species will be considered further in this assessment.
[7110] Active raised bogs (*if active bog)	Large area of raised bog located on lands 150 metres west of the Eighnagh River ca. 12km downstream of the proposed WTP upgrade at Cloongoonagh. This represents remote and tenuous connectivity between the proposed WTP upgrade site and this Annex I habitat. Therefore, this QI habitat will not be considered further in this assessment.
[7120] Degraded raised bogs still capable of natural regeneration	Tenuous – discrete parcels likely to be located on lands adjoining the River Moy main channel. There will be no changes to the hydrological regime of this habitat. Therefore, this QI habitat will not be considered further in this assessment.
[7150] Depressions on peat substrates of the *Rhynchosporion*	Tenuous – discrete parcels likely to be located on lands adjoining the River Moy main channel. There will be no changes to the hydrological regime of this habitat. Therefore, this QI habitat will not be considered further in this assessment.
[7230] Alkaline fens	Tenuous – discrete parcels likely to be located on lands adjoining the River Moy main channel. There will be no changes to the hydrological regime of this habitat. Therefore, this QI habitat will not be considered further in this assessment.
[91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	Tenuous – discrete parcels likely to be located on lands adjoining the River Moy main channel. Due to the nature of the proposed development there will be no impact to the structure and function of this habitat. Therefore, this QI habitat will not be considered further in this assessment.
[91E0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-padion, Alnion incanae, Salicion albae*)*	Tenuous – discrete parcels likely to be located on lands adjoining the River Moy main channel. This habitat lies on the banks of the River Moy and may be sensitive to hydrological changes and nutrient inputs Therefore, this QI habitat will be considered further in this assessment.

5.3 BASELINE ASSESSMENT OF QUALIFYING INTERESTS OF EUROPEAN SITES

Lough Talt is designated under Lough Hoe Bog SAC and the Eighnagh River is a tributary of the River Moy, which is designated as part of the River Moy SAC. Lough Talt, the Eighnagh River and the River Moy main channel provides suitable habitat to support those species for which Lough Hoe Bog SAC and the River Moy SAC are designated. These are predominantly water based or aquatic species associated with riverine habitats or their riparian zone. The habitats and species of qualifying interest screened in for further assessment in this NIS are presented in **Table 5.19**.

5.3.1 Baseline Assessment of Qualifying Species of Lough Hoe Bog SAC

The baseline assessments of the Annex II species of Lough Hoe Bog SAC (White-clawed Crayfish (*Austropotamobius pallipes*) and Geyer's Whorl Snail (*Vertigo geyeri*) are considered in **Section 5.3.1.1 and 5.3.1.2** below. There will be no impacts to the qualifying habitats of Lough Hoe Bog (Blanket bogs and oligotrophic lakes) due to nature of the proposed works and the lack of the proposed works connectivity, direct or indirect, with either of these habitats, see **Table 5.19**.

5.3.1.1 White-clawed Crayfish (*Austropotamobius pallipes*)

White-clawed Crayfish, the only freshwater crayfish species native to Ireland, is also protected under Annex II of the EU Habitats Directive. Their living requirements are similar to those of brown trout which require good water quality (above 50% oxygen saturation, BOD below 3 ppm) and moderate summer water temperatures (below 20°C) although they only feed actively and moult above 10°C. They are sensitive to acidity and heavy metals, but may tolerate disturbance or recolonise affected areas[20].

A study was carried out during the period June to October 2007 by Ecofact Environmental Consultants Ltd. on behalf of the NPWS. The study comprised a survey of 26 selected Irish lakes. The white-clawed crayfish is Ireland's only crayfish species and Ireland is thought to hold some of the best European stocks of this species, under least threat from external factors. It was concluded that Lough Talt was one of the most important lakes for crayfish, of those surveyed. Good stocks of Crayfish were observed here by Reynolds in 2006. In lakes such as Lough Talt, recent recruitment was detected and these lakes were found to contain a particularly good range of sizes, thus indicating a healthy population. It is documented that the Eighnagh River runs dry for 39 days per year on average during drought conditions. This may reduce the availability of suitable habitat within the river for the species during drought occurrences.

Ecofact conducted a survey of white-clawed crayfish in Lough Talt and the Eighnagh River in 2010 and 2016 as part of studies conducted for the Lough Talt RWSS WTP upgrade. Quantitative sampling was undertaken within 400 refuges within 4 stations along the shores of Lough Talt which included the northern eastern shoreline, southern shoreline, south eastern shoreline and the western shoreline. Surveys were also carried out on Eighnagh River sites using kick sampling methodology. The hand search method was used and followed that outlined in Reynolds (2006), in combination with snorkelling as in O'Connor *et al.*, (2009). The surveys were undertaken under licence from NPWS and followed standard NPWS and EPA protocols for sampling lake and stream macro-

[20] Reynolds, J.D. (1998) Conservation management of the white-clawed crayfish, *Austropotamobius pallipes*. Part 1. *Irish Wildlife Manuals*, No. 1.

invertebrates. Crayfish were found in all locations surveyed on the Eighnagh River and good populations of crayfish were recorded at Lough Talt.

A survey of aquatic macrophyte/riparian vegetation was also undertaken along the river corridor and in lake habitats. The output of the assessment has provided detailed data on which to base the current impact assessment, and also a comprehensive baseline dataset on which to assess any further changes on the lake and outflow river.

Table 5.20 gives the White-clawed Crayfish records, including abundance of White-clawed Crayfish (adult, hatchling and total), percentage male and female (excluding hatchlings) and Catch Per Unit Effort (CPUE) at four locations surveyed by hand searching on Lough Talt during October 2016. Summary statistics of crayfish results are provided in **Table 5.21** to **Table 5.22**. Calm and bright weather conditions at the time of the surveys represented ideal conditions for surveying.

In general, a healthy white-clawed crayfish population was recorded at all sites surveyed on the lake. Hatchlings were present at all locations; evidence of successful recent reproduction. These hatchlings were not weighed or measured due to their small size and delicate nature. The highest number of individual hatchlings occurred along the south shore at Site L1 (N=9) and on the western shore at Site L2 (N=8). The largest crayfish was captured at Site L2. This specimen was male. The carapace length of this individual was 33.6 mm and the total length was 69.2mm. It is noted that layers of rock/cobble at some patches made finding smaller specimens difficult, as they could move deeper into the interstices upon detection of disturbance. To this end, it is likely that some Crayfish present in potential refuges were not detected or recorded.

Table 5.20: Abundance of White-clawed Crayfish

Site	Post hatchling				Hatchling (N)	Total crayfish		% hatchlings
	N	% Male	% Female	CPUE[1]		(N)	CPUE[2]	
L1	20	40	60	0.20	9	29	0.29	31
L2	20	55	45	0.20	8	28	0.28	28.6
L3	26	50	50	0.26	6	32	0.32	18.8
L4	22	59.1	40.9	0.22	4	26	0.26	15.4

**CPUE Catch-Per-Unit-Effort: hand-searching of crayfish refuge.*
CPUE[1] refers to CPUE omitting hatchlings.
CPUE[2] refers to CPUE including hatchlings

Table 5.21: Summary statistics for carapace length (mm) for Crayfish captured during the October 2016 Survey on Lough Talt.

Site	N	Mean	Minimum	Maximum	St.Dev
L1	20	19.97	14.4	28.5	4.61
L2	20	23.93	13.4	33.6	5.96
L3	26	22.71	17	32	3.97
L4	22	22.84	15.2	31.1	4.32

Table 5.22: Summary statistics for total length (mm) for Crayfish captured during the October 2016 survey on Lough Talt.

Site	N	Mean	Minimum	Maximum	St. Dev
L1	20	41.43	29.2	58.5	9.5
L2	20	49.56	26.9	69.2	11.99
L3	26	46.98	34.5	67.3	8.67
L4	22	46.95	33	63.7	8.79

RPS undertook a statistical analysis of Crayfish survey efforts at Lough Talt undertaken in 2010 and again in 2016 to determine if there was a statistically significant difference in CPUE across all of the sampled crayfish sites. The findings of this statistical analysis are presented in **Table 5.23** below.

Table 5.23: Comparison between 2010 and 2016 CPUE1 and CPUE2 survey results

Site	CPUE1			CPUE2		
	2010	2016	Change	2010	2016	Change
L1	0.32	0.20	-0.12	0.43	0.29	-0.14
L2	0.19	0.20	0.01	0.31	0.28	-0.03
L3	0.26	0.26	0.00	0.38	0.32	-0.06
L4	0.51	0.22	-0.29	0.57	0.26	-0.31
Mean	0.32	0.22		0.42	0.29	
Standard Deviation	0.12	0.02		0.10	0.02	
S.ERROR	0.06	0.01		0.05	0.01	
p value*	0.25 (not significant)			0.12 (not significant)		

*p value > 0.05 is not significant, p value < 0.05 is significant

Comparing the data for CPUE1 and CPUE2 from sites L1-L4 between 2010 and 2016, RPS carried out a paired t-test that found no statistically significant change in CPUE1 ($t=1.43_3$ $p=0.248$) or CPUE2 ($t=2.28_3$ $p=0.12$). Although there are decreases in two sites within CPUE1 and across all sites in CPUE2, these are not deemed to be significant (p > 005). This analysis indicates that the population structure of White-clawed Crayfish has not changed at these sites between the 2010 and 2016 surveys.

5.3.1.2 Semi-Aquatic Snail *(Vertigo geyeri)* - Lough Hoe Bog SAC

The semi-aquatic Whorl Snail (*Vertigo geyeri)*, occurs in marsh vegetation on the shore on Lough Talt. This is a very rare, glacial relict species which is known in Ireland from only a few sites. It is rare and threatened in Europe and is listed on Annex II of the EU Habitats Directive.

The species requires saturated water conditions in saturated calcareous, ground fed flushes. Their habitats often in mosaics of suitable patches within wider fen macrohabitats, that in Ireland can themselves fall within wider site habitats that be as diverse as raised bog, transition mires, lake shores, hill or mountain slopes, and wetlands associated with coastal dunes and machair (Moorkens, 2003). Within these macrohabitats, however, the snail is consistent in where it lives, within the saturated and decaying roots of small sedges (particularly *Carex viridula ssp. brachyrrhyncha*), associated fen mosses (particularly *Drepanocladus revolvens* and *Campyllium stellatum*).

Molluscan surveys were carried out by Dr. Evelyn Moorkens from 2005 to 2008 on behalf of the NPWS as part of an ongoing monitoring programme, and between 2010 to 2016 on behalf of Sligo County Council and Irish Water to inform the assessment on the impacts of water abstraction from Lough Talt.

There are three areas around the shores of Lough Talt that are a known habitat for *Vertigo geyeri*. A fixed transect has been established along the eastern shore in the main habitat area (See **Figure 5-8**). The transect is a standard format for monitoring of this species, where detailed measurements are taken of micro-habitat changes and wetness levels into and out of good habitat, which varies considerably with micro-topography changes, and three samples are taken to analyse the molluscan content in the best habitat areas. This transect was established in 2005, and *V. geyeri* was found to be plentiful along the transect line in seepage zones. The transect was repeated in 2007 when the results were also favourable, and in 2008, when the habitat appeared to be in good condition, but no *V. geyeri* were found in the samples. For the purposes of understanding the current receiving environment, the transect was surveyed again in 2011, 2013 and 2016 for this investigation, and again no *V. geyeri* were found in the samples, see **Appendix C**.

Within its macro-habitat, the snail needs constancy of hydrological conditions, but with enough variation to provide refugia for the meteorological extremes that the habitat must endure. It requires an openness of habitat that prevents succession by shade loving plants and more competitive shade loving snails. An appropriate micro-habitat regime is a key requirement for the spring-seepage habitat to function to a level that will support *V. geyeri* and the many species that are protected under the umbrella of a habitat with this function.

A hydrogeological investigation was undertaken to investigate the linkage between the lake water levels and the groundwater flushes that support the habitat. The results of the assessment were used to determine the potential impact of water abstraction from the lake on the structure and function of the *Vertigo geyeri* habitat.

This was carried out by drilling three deep and shallow monitoring boreholes at the edge of the fen area, and placing six shallow piezometers within the *V. geyeri* habitat area (RPS, 2014). The suite of piezometers were placed to ensure they were relevant to the snail habitat, but not exactly in key habitat areas in order to avoid direct damage to the spring/seepage habitat function.

To provide more accurate information, loggers were installed in all six piezometers, and to relate the logged water level information with the exact conditions of the *V. geyeri* habitat, by measuring the micro-topography range within the habitat and to assess the function of the habitat during a wet and a dry part of the annual hydrological fluctuation.

The *Vertigo geyeri* habitat is located in the peat soils of the fen. The site investigation results have shown the habitat is underlain by a gravel aquifer that extends to at least 15m below ground level.

The groundwater flow direction is towards the lake and the lake is considered to be in hydraulic continuity with the gravel aquifer. The gravel aquifer is confined by a thin clay layer close to the lake but is unconfined further upslope to the north east at BH3d. Due to the poor transmissivity of the underlying groundwater body, groundwater interactions are likely to be local therefore not influencing hydrogeological pathways or their reliant ecosystems in the surrounding locality. The presence of the groundwater flushes in the vicinity of the habitat is considered to be a result of artesian conditions in the gravel aquifer where groundwater under pressure discharges diffusely at surface where the confining clay layer is absent.

Monitoring of the piezometers within the habitat area shows the groundwater head in the shallow peat soils drops below ground during extended dry periods, when the head in the underlying gravel aquifer drops below ground level it no longer supports the surface groundwater discharges and the habitat requirements for the snail.

The results from the March and September ecological 2016 studies suggest that the habitat appears to be ideal for *V. geyeri* and related fen spring-seepage specialist species, with the exception of the uppermost (PZ6) and the lowermost (PZ1) quadrats. At higher ground there appears to be too great a loss of connection with the groundwater to be ideal, and at low ground the rocky flatter ground results in poor resilience of habitat for specialist species that demand an even supply of water and humidity. Therefore, the ideal habitat is restricted to a narrow band of habitat that enjoys a constant and even supply of phreatic pressure and groundwater seepage.

Over the last 9 years a number of possible causes of loss of *V. geyeri* and its fen allied species were proposed as possibilities – including external drainage, changes in weather patterns, excessive flooding or excessive drought. From conditions on the ground over the years, flooding seemed more likely than drought. However, the habitat currently looks ideal and demonstrates all the requirements of high quality fen seepage-meadow conditions, thus external drainage and rainfall patterns are unlikely to be the cause.

Severe once-off flooding is also unlikely to be the cause as there are plenty of pockets of higher ground that could have acted as Refugia to the less sensitive species. The lack of recovery of the fen specialist species suggests that they were extirpated from quite a wide area, suggesting the cause was more likely to have been a severe low water deficit, resulting in a dearth of refugia for the wet terrestrial specialists.

During droughts, wet terrestrial species take refuge in pockets of habitat that are normally inundated but become barely saturated in droughts. In order to extirpate a range of species for 9 years, it is likely that the wet zone refuge areas became too dry to support the more sensitive species. Tolerance to drying is low in these species, and thus loss can occur in a few days. In contrast, even though *Pisidium personatum* and *Galba truncatula* generally live in wetter conditions than *V. geyeri*, they are adapted to withstanding drying out for a much longer period of time as they are much less sensitive species.

Analysis of the head distributions throughout the gravel aquifer have shown that these are directly controlled by the lake level during dry conditions when any influence of direct precipitation is absent. When the lake level drops during a recession period this propagates a drop in the groundwater levels back through the gravel aquifer.

Analysis of the logger data has shown the cessation of artesian conditions occurs at PZ2, PZ3 and PZ4 when the lake level drops below 135.66maod. The current lake abstraction operation results in the lake level dropping below this level on an annual basis during dry weather. The continued abstraction from the lake when the water level drops below the 135.66maod, has an impact on the artesian conditions within the fen, which supports are hydrogeological conditions of the habitat.

Full details of the 2015/2016 Molluscan Survey of Lough Talt are provided in **Appendix C.** The Conservation Objective for Geyer's Whorl snail at Lough Hoe Bog is to restore the favourable conservation condition of Geyer's Whorl Snail in Lough Hoe Bog SAC.

Figure 5-8: Lough Talt –*Vertigo geyeri* habitat and sample areas

5.3.2 Baseline Assessment of Qualifying Habitats and Species of River Moy SAC

Potential impacts associated with the construction, operation and decommissioning of the Lough Talt RWSS WTP upgrade to the habitats and species of the River Moy SAC within the project zone of influence are considered below. With the exception of the Annex I habitat 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) [91E0]', there are no potential impacts to the qualifying habitats of River Moy SAC due to the lack of the proposed works connectivity, direct or indirect, with these habitats, see **Table 5.19**.

5.3.2.1 Atlantic Salmon (*Salmo salar)* - River Moy SAC

The Atlantic salmon is listed under Annexes II and V of the EU Habitats Directive and Appendix III of the Bern Convention. The River Moy is one of the most productive salmon fisheries in Western Europe. The main channel of the River Moy and a number of its tributaries are designated under the S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations, 1988; however the Eighnagh River is not designated as a salmonid water under these Regulations.

The Moy system is one of Ireland's premier salmon waters and it also encompasses two of Ireland's best lake trout fisheries in Loughs Conn and Cullin. Although the Atlantic Salmon (*Salmo salar*) is still fished commercially in Ireland, it is considered to be endangered or locally threatened elsewhere in Europe and is listed on Annex II of the EU Habitats Directive. The Moy is a most productive catchment in salmon terms and this can be attributed to its being a fingered system with a multiplicity of 1st to 5th order tributaries which are large enough to support salmonids less than 2 years of age while at the same time being too small to support significant adult trout numbers and are therefore highly productive in salmonid nursery terms. Atlantic Salmon run the Moy all year with both multi sea winter fish and grilse present. Spring Atlantic Salmon are found more frequently in those rivers located along the western extent of the Moy system (NPWS, 2014).

A Water Framework Directive surveillance monitoring fish stock survey was carried out on Lough Talt between the 22nd and 24th of September 2008 by staff from the Central Fisheries Board and the North-western Regional Fisheries Board. A total of five fish species were recorded in Lough Talt including Brown Trout (*Salmo trutta*), Arctic Char (*Salvelinus alpinus*), Perch (*Perca fluviatilis*), Eel (*Anguilla anguilla*) and Three-spined Stickleback (*Gasterosteus aculeatus*). Atlantic Salmon (*Salmo salar*) was not recorded at the lake during this survey; however they have been recorded downstream in the Eighnagh River (IFI, 2008).

Further assessments were undertaken by IFI in 2011 and again in 2014. In 2011, again a total of five species were recorded; brown trout was the most abundant fish species recorded, followed by Arctic char, perch, three-spined stickleback and eels. In 2014, five species were again recorded; three-spined stickleback was the most abundant fish species recorded, followed by brown trout, perch, Arctic char and eels i.e. the same species composition as in 2008 and 2011.

Aquatic Ecology and Fisheries Assessments were completed by Ecofact in 2010 and 2011/12. From these assessments it was determined that the Eighnagh River contained good salmonid habitats as it contained a sequence of pool, glide and riffle flow features. The stretch from the Lough Talt to approximately 300 meters downstream of the lake was high gradient and generally unsuited to holding fish due to rapid currents, or for spawning fish due to the rocky substrate. It was considered that this high gradient stretch downstream of the lake could be impassable to migrating salmonids. Therefore, it is concluded that Atlantic salmon do not enter Lough Talt.

Further downstream the Eighnagh River was considered a very strong habitat unit for the early life stages of salmonids. It had all the attributes associated with a salmon nursery stream; good physical diversity, holding pools large enough for holding adult trout and salmon prior to spawning, variety of gravel sizes of suitable size for spawning, very good water quality, rich macro invertebrate assemblage that was indicative of a ‘Predictable’ juvenile salmon food supply along with rocks and riffles that provide cover for young fish. In addition, where the river converges with the larger Lough Hoe River is deemed a very important nursery for salmonids also.

5.3.2.2 Lamprey - River Moy SAC

Two species of lamprey are included in the qualifying interests for the River Moy SAC, Brook lamprey *(Lampetra planeri*) and Sea Lamprey *(Petromyzon marinus*). The brook lamprey is the smallest of the three lamprey species native to Ireland and it is the only one of the three species that is non-parasitic and spends all its life in freshwater (Maitland & Campbell, 1992). All lamprey species are listed in Annex II of the EU Habitats Directive, 1992. All three species are listed in Appendix III of the Berne Convention.

The Moy SAC only covers the freshwater portion of the River Moy. The adjacent Killala Bay/Moy Estuary SAC (site code: 000485) encompasses the estuarine elements of sea lamprey habitat (NPWS, SSCO, 2016). Sea lamprey (*Petromyzon marinus*) is associated with those remote downstream areas near Ballina where the River Moy main channel becomes tidal. This species is located outside of the ZoI of the Lough Talt RWSS WTP upgrade and will not be impacted.

Brook lamprey are widespread throughout the Moy system (NPWS, 2014). Only Brook and River Lampreys were recorded in the Eighnagh River (Lough Talt River) in a survey conducted by Ecofact in 2004 of *Juvenile Lamprey Populations in the Moy Catchment* (Irish Wildlife Manuals, No. 15. 2004). Lamprey spawning grounds are located in the eroding reaches of tributary rivers and they require soft silt beds in their juvenile life.

Juvenile lampreys *(Lampetra sp.)* were present at the two sites investigated (located >5km downstream of the Lough Hoe Bog River confluence) on the Eighnagh River in 2004, however no evidence of recent spawning was found. During this survey the upper reaches of the Eighnagh River was also visited but not sampled due to the absence of suitable habitat. These species were not recorded in the immediate vicinity of the proposed scheme. **Figure 5-9** is a map of the Moy catchment illustrating the location of the surveyed and un-surveyed areas. Site specific conservation objectives for lamprey are presented in **Table 5.27**.

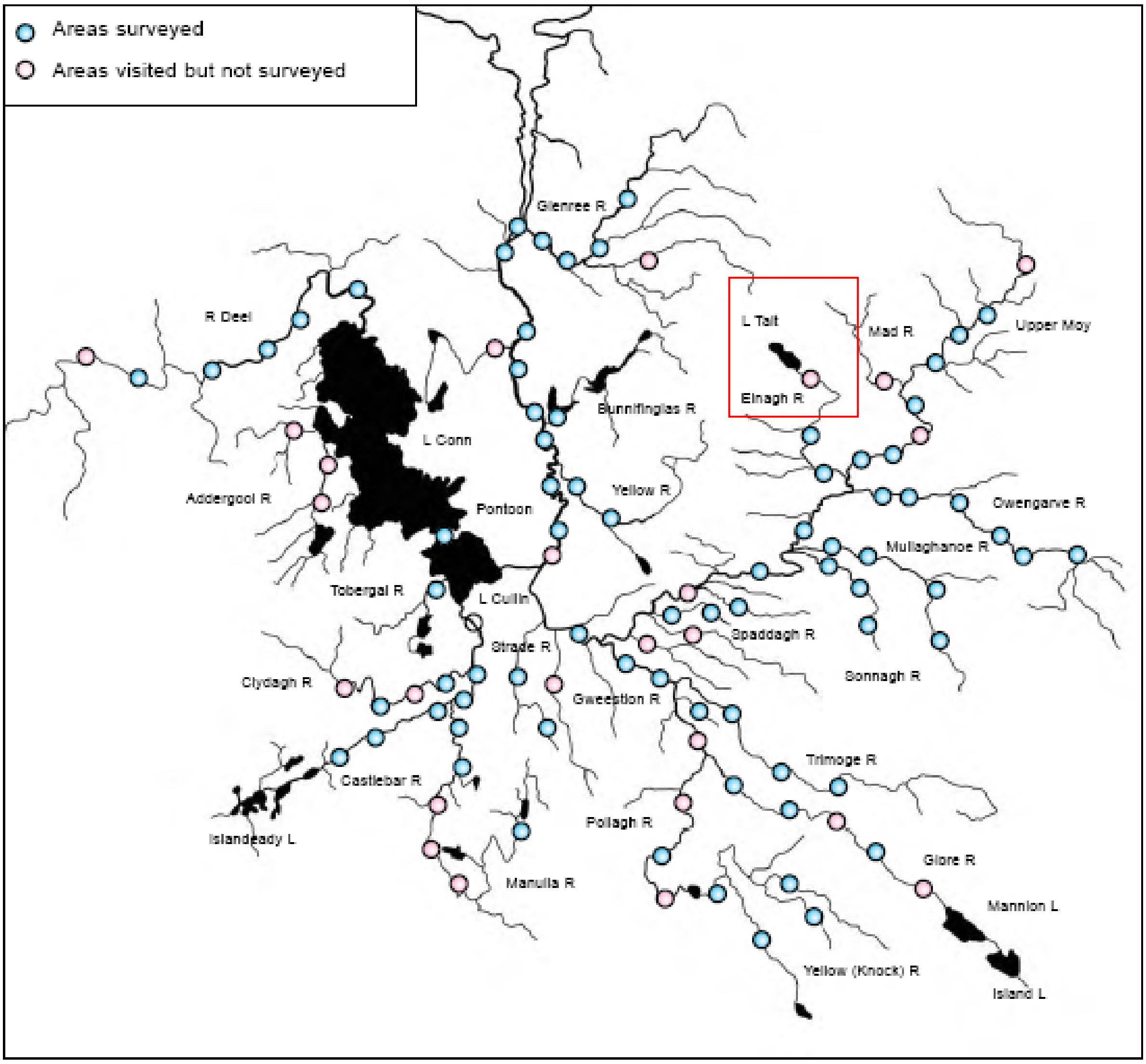


Figure 5-9 Map of the Moy Catchment illustrating the location of the surveyed areas

5.3.2.3 Otter (*Lutra lutra*) - River Moy SAC

Otter are a qualifying species of the River Moy SAC and are listed on Annex II and Annex IV of the EU Habitats Directive and also on the Wildlife Act 1976, as amended. Annex II species require the designation of protected areas by Member States (Special Areas of Conservation) as set out in Article 3, 4 and 6 of the Directive. Annex IV species require strict protection measures by Member States in accordance with Article 12 of the Directive, the Eurasian Otter is also listed on Appendix 1 of CITES and Appendix II of the Bern Convention. The Irish population is also listed in the '*Irish Red Data Book 2: Vertebrates*' (Whilde, 1993) as being of international importance.

Otters are largely solitary, territorial and nocturnal animals and in many areas their distribution is scarce. They are rarely found far from water and tend to occupy linear home ranges along watercourses and coasts. In general, however, otters exploit a narrow strip of habitat at the aquatic – terrestrial interface (O'Neill, 2008). The extent of otter habitat in Ireland has been estimated on the basis of four classes of water bodies: rivers, streams, lakes and coast (high water mark). In addition to the aquatic habitat, a 10m riparian buffer (both banks) is considered to comprise part of the otter habitat as discussed in the Threat Response Plan for otter prepared by the National Parks and Wildlife Service (NPWS, 2009).

They require suitable bankside vegetation as cover for their burrows or rest sites. Underground shelters are called *holts* and above ground sites are called *couches*. Otters may dig their own holts but they very often make use of other structures ranging from enlarged rabbit holes and cavities amongst tree roots to rock piles and manmade structures.

Otters mark their home ranges by depositing their droppings termed "spraints", at distinct landmarks such as grassy mounds, large rocks or ledges under bridges. These favoured sites are known as seats and are usually found at important locations; i.e. access points to the water, good fishing grounds. Other signs, such as footprints, fish remains, slides, etc. are also recorded.

Although there are no seasonal requirements for otter surveying, dense vegetation in areas along the riverbanks may reduce success in the identification of otter holts and couches. In addition spraints may also have been washed away following a period of heavy rain fall or flooding.

The National Biodiversity Data Centre did not support records of otter at the proposed development site or immediately downstream along the Eighnagh River. However, those areas of the Eighnagh River located further downstream, in addition to the River Moy main channel support records for otter. The NPWS online database support records for otter within the Lough Talt RWSS WTP upgrade.

Otter surveys were conducted as part of the multi-disciplinary ecological surveys conducted on the 14th March 2009, 28th and 29th August 2010, 13th January 2011, 26th January 2015 and 15th September 2015. Surveys for otter holts and signs were conducted in the winter months when vegetation has died back to ensure that this seasonal constraint did not impact on the completeness of the findings of the surveys. During the multidisciplinary surveys during the spring/summer months all signs of otter were recorded. Signs were recorded on the banks of rivers and streams during terrestrial surveys. Holts and signs were searched for in the banks of the rivers and islands within the watercourses during aquatic surveys. Otters have large ranges so surveys were carried out on the shores of Lough Talt and for approximately 1.5km downstream on the Eighnagh River.

A number of otter signs, in the form of otter spraints were found on rocks around the lake and at the outfall of Lough Talt into Eighnagh River. Otter spraint has also been recorded on the banks of the Eighnagh River; 500m downstream of Lough Talt. No holts were recorded within the study area, however the islands in Lough Talt may provide suitable habitat.

5.3.2.4 White-clawed Crayfish (*Austropotamobius pallipes*)

Ecofact conducted a survey of white-clawed crayfish in Lough Talt and the Eighnagh River in 2010 and 2016 as part of studies conducted for the Lough Talt RWSS WTP upgrade. Surveys were carried out on Eighnagh River sites using kick sampling methodology. The surveys were undertaken under licence from NPWS and followed standard NPWS and EPA protocols for sampling lake and stream macro-invertebrates. Crayfish were found in all locations surveyed on the Eighnagh River.

A survey of aquatic macrophyte/riparian vegetation was also undertaken along the river corridor and in lake habitats. The output of the assessment has provided detailed data on which to base the current impact assessment, and also a comprehensive baseline dataset on which to assess any further changes on the lake and outflow river.

The surveys conducted did not show any results that indicated the presence of alien crayfish species. No indications of disease were found within the population surveyed as part of the Ecofact 2016 surveys.

5.3.2.5 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alion incanae, Salicion albae)

This habitat has been recorded within the SAC on the western shore of Lough Conn, however there, there are also likely to be additional areas of this Annex I woodland type within the SAC. This habitat was not recorded in proximity to the WTP or on the banks of the Eighnagh River. There will be no direct loss of this habitat.

5.4 IMPACT ASSESSMENT

5.4.1 Characterising Impacts

The methodology for the assessment of impacts is derived from the Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites (EC, 2002). When describing changes/activities and impacts on ecosystem structure and function, the types of impacts that are commonly presented include:

- Direct and indirect effects,
- Short- and long-term effects,
- Construction, operational and decommissioning effects, and
- Isolated, interactive and cumulative effects.

Impacts that could potentially occur through the implementation of the project can be categorised under a number of impact categories as outlined in the EC 2002 document as follows:

- Loss/Reduction of habitat area,
- Disturbance to key species,
- Habitat or species population fragmentation,
- Reduction in species density, and
- Changes in key indicators of conservation value such as decrease in water quality and quantity.

5.4.2 Meaning of 'Adversely Affect the Integrity of the Site'

The concept of the 'integrity of the site' is explained in the EU publication Managing Natura 2000 sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, as follows;

'It is clear from the context and from the purpose of the directive that the 'integrity of the site' relates to the site's conservation objectives. For example, it is possible that a plan or project will adversely affect the integrity of a site only in a visual sense or only habitat types or species other than those listed in Annex I or Annex II. In such cases, the effects do not amount to an adverse effect for purposes of Article 6(3), provided that the coherence of the network is not affected. On the other hand, the expression 'integrity of the site' shows that focus is here on the specific site. Thus, it is not allowed to destroy a site or part of it on the basis that the conservation status of the habitat types and species it hosts will anyway remain favourable within the European territory of the Member State.

As regards the connotation or meaning of 'integrity', this can be considered as a quality or condition of being whole or complete. In a dynamic ecological context, it can also be considered as having the sense of resilience and ability to evolve in ways that are favourable to conservation. The 'integrity of the site' has been usefully defined as 'the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified'

A site can be described as having a high degree of integrity where the inherent potential for meeting site conservation objectives is realised, the capacity for self-repair and self-renewal under dynamic conditions is maintained, and a minimum of external management support is required. When looking at the 'integrity of the site', it is therefore important to take into account a range of factors, including the possibility of effects manifesting themselves in the short, medium and long-term.

The integrity of the site involves its ecological functions. The decision as to whether it is adversely affected should focus on and be limited to the site's conservation objectives.

5.4.3 Potential Impacts during the Construction Stage

5.4.3.1 Construction Stage Impacts on Lough Hoe Bog SAC

There will be no construction stage impacts on Lough Hoe Bog SAC. The proposed development will not require the construction of new or upgraded infrastructure at Lough Talt / Lough Hoe Bog SAC. Abstraction of raw water from Lough Talt will continue with a treated water production capacity of 8 MLD matching the current abstraction levels.

5.4.3.2 Construction Stage Impacts on River Moy SAC

There is potential for pollutants associated with the project's construction phase to enter surface water channels draining the proposed WTP upgrade continuing south to the Eighnagh River. The Eighnagh River is designated as part of the River Moy SAC.

The individual elements associated with the proposed WTPs construction that are likely to result in impacts to the River Moy SAC are as follows:

- Generation of silt laden waters and potential construction phase pollutants; e.g. silted waters, hydrocarbons, cement, bituminous materials etc. carrying such potential pollutants to the site's drainage channels and draining the site via overland flow (which support connectivity with the Eighnagh River); and
- Excavation and importing of parent material during the project's construction phase.

The proposed works will require the importation of material for construction including aggregate (clay, sand and gravel) for the WTP and surrounds, tarmac and concrete pouring equipment, steel and timber. Fuel will be consumed by construction equipment while water will be required for various construction practices. There will be no requirement for water or any other resources to be taken from natural resources during the construction of the WTP upgrade. In the absence of mitigation, there is the potential for these pollutants to leave the proposed WTP upgrade via the site's drainage channels.

There is potential for emissions associated with the project's construction phase affecting two main sources; i.e. water and air. Emissions emanating to water could include fine sediment, silt, and hydrocarbons from plant machinery associated with the project's construction phase.

Emissions to air will include fine particulate matter associated with ongoing excavations and other construction practices. Such emissions have the potential to impact negatively on the qualifying features of the River Moy SAC (specifically the aquatic environment and those aquatic Qualifying species of the River Moy SAC). However, the implementation of standard best practice, informed by a Construction Environmental Management Plan (CEMP) (**Appendix F**), can effectively safeguard against all potential emission sources associated with the project's construction phase.

There will be a requirement to excavate parent material during the construction phase of the proposed WTP upgrade. In the absence of best practice, such excavation requirements could impact proximal and adjoining watercourses through the continued and sustained release of sediment and particulate matter. There will be no excavation requirements during the project's operational phase. Excavation volumes and parent materials associated with the project's construction phase will be informed by the SI works. As part of the project's construction phase, sustained and ongoing transport of personnel and raw materials will be required within the land-take and immediate surrounds of the proposed WTP upgrade site. In addition, haulage of raw materials and aggregate material will be required throughout the projects construction phase. In the absence of best practice and construction design, ongoing and sustained transport during the construction phase could influence particulate matter levels in receiving watercourses draining the site that in turn could impact those sections of the River Moy SAC located downstream. However, the implementation of standard best practice, informed by a CEMP, will effectively safeguard against all potential emission sources associated with the project's construction phase.

The proposed WTP upgrade will be constructed over a time period of approximately 9 months and any resulting significant effects will be temporary in nature and restricted to the footprint of the proposed development site. Timing of works during periods of seasonally low flows; i.e. May to October, will limit the risk of water based pollutants being released from the site, especially following sustained rainfall events.

5.4.4 Potential Impacts during the Operation Stage

5.4.4.1 Operation Stage Impacts on Lough Hoe Bog SAC

5.4.4.1.1 Operation Stage Impacts on Lough Hoe Bog SAC QI Habitats

There will be no impact to the qualifying habitats of the Lough Hoe Bog SAC from the operation of the WTP upgrade.

5.4.4.1.2 Operational Stage Impacts on Lough Hoe Bog SAC QI Species

The operational stage impacts associated with the water abstraction for the Lough Talt WTP upgrade include drawdown of water levels within the Lough Talt waterbody and consequent impacts to groundwater dependent fen habitat which supporting the qualifying interest species *Vertigo geyeri*.

A hydrogeological investigation was undertaken to investigate the linkage between the lake water levels and the groundwater flushes that support the habitat. The results of the assessment were used to determine the potential impact of water abstraction from the lake on the structure and function of the habitat. From the *Vertigo geyeri* baseline assessment in **Section 5.3.1.2**, the current lake abstraction operation results in the lake level dropping below a critical level to sustain the *Vertigo geyeri* habitat on an annual basis during dry weather. The continued abstraction from the lake when the water level drops below 135.66maod elevation, has an impact on the artesian conditions within the fen, which are the supporting conditions for the habitat. The impacts on the conservation objectives of *Vertigo geyeri* are assessed further in **Section 5.4.2.1.1**.

5.4.4.2 Operation Stage Impacts on River Moy SAC

5.4.4.2.1 Operation Stage Impacts on River Moy SAC QI Habitats

There will be no discharge of treated water or wastewater from the proposed WTP upgrade. All washwaters and by-product water generated will be recirculated back into the WTPs system. Surface water will be collected, attenuated and discharged via a hydrocarbon interceptor to the existing drainage channels on-site which ultimately discharge to the Eighnagh River. Sludge generated during the water treatment process will be thickened and dewatered within the bounds of the WTP. Once sufficiently thickened and dewatered, sludge will be re-used off-site or disposed at a licenced waste facility.

There will be no discharges from the proposed WTP upgrade to the surrounding environment and by extension the Eighnagh River / River Moy SAC. With the exception of surface water, all potential operational phase pollutants will be regulated and recirculated within the proposed WTP upgrade. All potential pollutant sources associated with the water treatment process (such as chemicals, lubricants, hydrocarbons etc.) will be located to within the bounds of the proposed WTP upgrade in bunded, secure holding areas.

There will be no aqueous emissions or by-product output during the proposed WTPs operational phase and thus no potential for impact in this regard. All aqueous materials will be recirculated back into the water treatment process.

There will be no excavation requirements associated with the projects operational phase and thus no potential for associated impacts.

Transport requirements during the project's operational phase will involve routine visits by site operation and maintenance staff. Such transport requirements will not impact upon European sites.

Potential operational impacts to the Annex I habitat Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) [91E0] within the River Moy SAC, is discussed further in **Section 5.4.2.2.5.**

5.4.4.2.2 Operation Stage Impacts on River Moy SAC QI Species

Under the existing rate of abstraction of 8 MLD condition, during dry periods, the Eighnagh River dries out between the outflow from the lake to the river to its confluence with the Lough Hoe River 300m downstream. There are indications that there is no flow from Lough Talt for 39 days of an average year in the upper 300m of the Eighnagh River, see **Section 5.1.2.2**.

The Eighnagh River from Lough Talt to approximately 300 meters downstream of the lake is high gradient and generally unsuited to holding fish due to rapid currents, or for spawning fish due to the rocky substrate and therefore does not provide suitable habitat for qualifying interest species such as Atlantic Salmon and brook lamprey, therefore there will be no significant adverse effect to these species.

Species such as otter may be impacted during drought conditions due to a reduction in prey abundance and availability.

White-clawed crayfish may be affected during these periods of drought in the Eighnagh River through barriers to migration, loss of refugia and foraging grounds. The impact assessment on the conservation objectives for White-clawed Crayfish associated with Lough Hoe Bog SAC is presented in **Section 5.4.2.2.4**.

5.4.1 Potential Impacts during the Decommissioning Stage

Irish Water is applying to Sligo County Council for planning permission to upgrade the existing WTP and continue to use the upgraded WTP for a period of 10 years, after which time the WTP will be decommissioned and the abstraction of raw water from the lake will cease once the replacement source is in place.

The cessation of the abstraction of 8,000m^3/day from Lough Talt will potentially increase the levels in the lake as well as the discharge from the lake to the Eighnagh River. The outflow to the river is proportional to the lake level so the cessation of the abstraction will initially lead to a slight increase in lake levels but ultimately will lead to increased outflows from the lake. The Eighnagh River has a 5%ile flow of 1.667 m^3/sec at a point approximately 500m downstream of the lake outfall. This corresponds to the flowrate that is exceeded 5% of the time. The increased discharge from the lake will increase this flow by 0.0925 m^3/sec or approximately 5.5%. For higher flow events and at points further downstream the effect will be even less. There is no history of flooding along this section of the river (www.floodmaps.ie) and as such the small increase in river flows is not expected to lead to any increase in flooding downstream. There are three locations in the vicinity of the lake with flooding history but these were identified as occurring during heavy rain as a result of runoff coming off high ground and not from the lake itself. During periods of low flow the cessation of the abstraction will increase the flow rate in the river. The 95% flow in the river at the same location (i.e. approx. 500m downstream of the lake outfall) is 0.037 m^3/sec. The cessation of the abstraction will increase the flow in the river by up to 250% during these conditions.

5.4.1.1 Decommissioning Stage Impacts on Lough Hoe Bog SAC

5.4.1.1.1 Decommissioning Stage Impacts on Lough Hoe Bog SAC QI Habitats

There will be no decommissioning stage impacts on the qualifying habitats of Lough Hoe Bog SAC.

5.4.1.1.2 Decommissioning Stage Impacts on Lough Hoe Bog SAC QI Species

The cessation of water abstraction during the decommissioning stage will result in a positive effect on the surface water and groundwater regime of the lake and consequently positively affect the water dependent habitats and species of the Lough Hoe Bog SAC as naturally occurring drought conditions will not be exacerbated by the continued abstraction of 8MLD, which will provide more habitat in the littoral zone of Lough Talt for White-clawed Crayfish and the hydrological regime of the fen habitat will return to a more natural state.

Prey abundance and availability for species such as otter will also increase.

5.4.1.2 Decommissioning Stage Impacts on the River Moy SAC

5.4.1.2.1 Decommissioning Stage Impacts on River Moy SAC QI Habitats

There is potential for pollutants associated with the project's decommissioning phase to enter surface water channels draining the proposed WTP upgrade continuing south to the Eighnagh River. The Eighnagh River is designated as part of the River Moy SAC.

5.4.1.2.2 Decommissioning Stage Impacts on River Moy SAC QI Species

Under the existing rate of abstraction of 8 MLD condition, during dry periods, the Eighnagh River dries out between the outflow from the lake to the river to its confluence with the Lough Hoe River 300m downstream. There are indications that there is no flow from Lough Talt for 39 days of an average year in the upper 300m of the Eighnagh River, see **Section 5.1.2.2**.

The cessation of water abstraction during the decommissioning stage will affect surface water regime of the river outflow and will consequently result in a positive effect on the water dependent species of the River Moy SAC as naturally occurring drought conditions will not be exacerbated by the abstraction of 8MLD, and it is unlikely that the Eighnagh River will dry out annually thereby providing more habitat for aquatic species such as White-clawed Crayfish during drought conditions.

Prey abundance and availability for species such as otter will also increase.

5.4.2 Impacts to the Qualifying Interests of European Sites

The qualifying habitats and species designated as part of the Lough Hoe Bog SAC and River Moy SAC that may potentially be impacted by the Lough Talt RWSS in the absence of mitigation are discussed in greater detail below. The habitats and species of qualifying interest screened in for further assessment in this NIS are presented in **Table 5.19**.

When determining the impacts on the qualifying interests of European sites during the project's construction, operation and decommissioning phases, the conservation objectives including the attributes, measures and target as listed for those habitats and species are taken into account.

5.4.2.1 Impact Assessment of Qualifying Habitats and Species of Lough Hoe Bog SAC

5.4.2.1.1 White-clawed Crayfish [1092] - Lough Hoe Bog SAC

Statistical analysis of white-clawed crayfish surveys completed at Lough Talt in 2010 and again in 2016 confirms that there was no statistically significant change in CPUE across the four sample sites. Analysis of this data confirms that there is no change in abundance or density during this period, when abstraction of water from Lough Talt was ongoing. It is therefore considered that impacts to White-clawed Crayfish populations at Lough Talt have not been, nor will they experience significant adverse effects by the proposed Lough Talt WTP upgrade and associated water abstraction.

The impact assessment on the conservation objectives for White-clawed Crayfish associated with Lough Hoe Bog SAC is presented in **Table 5.24**.

Table 5.24: Conservation Objectives Assessment of Lough Hoe Bog SAC: [1092] White-clawed Crayfish (*Austropotamobius pallipes*)

Attribute	Measure	Target	Notes	Impact Assessment
Distribution	Number of occupied 1km grid squares	No decline	The records for white-clawed crayfish (*Austropotamobius pallipes*) in Lough Hoe SAC all come from Lough Talt. This lake overlaps five 1km grid squares and the species has been recorded from three of these squares, G3815, G3914, G3915. See map 5. There is no	Lough Talt was surveyed on a number of occasions by Ecofact in 2007, 2010 and 2016. White-clawed Crayfish were collected by hand searching in 100 potential refuges from the littoral zone of the four sites around the lake during early-October 2016. In general, a healthy white-clawed crayfish population was recorded at all sites surveyed on the lake. The site was divided into four

Attribute	Measure	Target	Notes	Impact Assessment
			reason to suppose it is not present in G4014 and G4015, but this needs confirmation	study areas, L1 – L4, and each had 100 refuges for crayfish which were searched. The current rates of abstraction are to be maintained; therefore the continued abstraction from the lake for the duration of the operation of the WTP upgrade is unlikely to have a significant effect on the distribution of white-clawed crayfish within Lough Talt.
Population structure: recruitment	Occurrence of juveniles and females with eggs	Juveniles and / or females with eggs should be present in all occupied 1km squares, subject to natural processes and availability of suitable habitat	See Reynolds et al. (2010) for further details	Statistical analysis of white-clawed crayfish surveys completed at Lough Talt in 2010 and again in 2016 confirms that there was no statistically significant change in CPUE across the four sample sites. The current rates of abstraction are to be maintained; therefore the continued abstraction from the lake for the duration of the operation of the WTP upgrade is unlikely to have a significant effect on the population structure of white-clawed crayfish within Lough Talt.
Negative indicator species	Occurrence	No non-indigenous crayfish species	Non-indigenous crayfish species (NICS) are identified as a major direct threat to the white-clawed crayfish *Austropotamobius pallipes*) and as a disease vector, in particular crayfish plague (*Aphanomyces astaci*), which is fatal to white-clawed crayfish. Ireland is currently free of NICS. See Reynolds (1998) for further details	The surveys conducted to date did not show any results that indicated the presence of alien crayfish species. However, any future surveys or maintenance activities will be conducted in accordance with strict biosecurity measures, as outlined in the guidance of the Inland fisheries Ireland Biosecurity Protocol for Field Survey Work (2011) to ensure no negative impacts are caused to other watercourses. http://www.fisheriesireland.ie/fisheries-research-1/73-biosecurity-protocol-for-field-survey-work-1
Disease	Occurrence	No instances of disease	There have been outbreaks of crayfish plague (*Aphanomyces astaci*) in Ireland since 2015 and it is thought that human activity, especially the carrying of disease vectors on contaminated equipment, has introduced and spread the disease. Strict biosecurity	No indications of disease were found within the population surveyed as part of the Ecofact 2016 surveys. However, any future surveys or maintenance activities will be conducted in accordance with strict biosecurity measures, as outlined in the guidance of the Inland fisheries Ireland Biosecurity Protocol for Field Survey Work

Attribute	Measure	Target	Notes	Impact Assessment
			is required	(2011) to ensure no negative impacts are caused to other watercourses. http://www.fisheriesireland.ie/fisheries-research-1/73-biosecurity-protocol-for-field-survey-work-1 Any instances of the disease will be reported to the IFI and NPWS
Water quality	EPA Q Value	At least Q3-4 at all sites samples by the EPA	Target taken from Demers and Reynolds (2002). Q values based on triennial water quality surveys carried out by the Environmental Protection Agency (EPA)	Lake Waterbody WFD Status 2013-2015 indicate that Lough Talt is of *Good* status.
Habitat quality: heterogeneity	Occurrence of positive habitat features	No decline in habitat quality	Crayfish need high habitat heterogeneity. Larger crayfish must have stones to hide under, or an earthen bank in which to burrow. Hatchlings shelter in vegetation, gravel and among fine tree-roots. Smaller crayfish are typically found among weed and debris in shallow water. Larger juveniles in particular may also be found among cobbles and detritus such as leaf litter. These conditions must be available throughout the area of occupied habitat	During the course of the 2016 survey, substrates at Lough Talt were found to support algae and silt. It is possible that some enrichment of Lough Talt may have taken place since the 2010 survey, which may reduce the heterogeneity of the habitat. It is not clear as to source of enrichment. It is speculated that landslides within the catchment, forestry, intensive grazing and malfunctioning domestic septic tanks may be cumulatively contributing to the enrichment of the lake. The management of these external factors are outside the scope of this project. The current rates of abstraction are to be maintained; therefore the continued abstraction from the lake for the duration of the operation of the WTP upgrade is unlikely to have a significant effect on the habitat quality of white-clawed crayfish within Lough Talt.

5.4.2.1.1 *Vertigo geyeri* [1013] - Lough Hoe Bog SAC

The alkaline fen habitat on the north-eastern shores of Lough Talt is important for the rare Annex II Geyer's whorl snail (*Vertigo geyeri*). *V. geyeri* was first recorded at Lough Talt in 1992 and was last recorded at the site in 2007.

The fen habitat is not fenced and is not actively managed by grazing. There is evidence that heather bushes have been burnt in the recent past, and a little littering nearby suggests this is recreation damage. Otherwise, management of the area and prevention of succession is due to the wetness of the area. Some tracks within the habitat may be from boat trailers and quad bikes accessing the area and this has led to some damage.

RPS has undertaken a hydrogeological investigation and impact assessment of the *V. geyeri* habitat on the eastern shore of Lough Talt, Co. Sligo to determine the potential impact of water abstraction from the lake for human consumption on the *V. geyeri* habitat. The purpose of the investigation was to assess the linkage between the lake water levels and the groundwater flushes that support the habitat.

The *V. geyeri* habitat is located in the peat soils of the fen. The site investigation results have shown the habitat is underlain by a gravel aquifer that extends to at least 15m below ground level. The groundwater flow direction is towards the lake and the lake is considered to be in hydraulic continuity with the gravel aquifer and acts as a discharge boundary for the groundwater flow through the gravel deposit.

Analysis of the head distributions throughout the gravel aquifer have shown that these are directly controlled by the lake level during dry conditions when any influence of direct precipitation is absent. Therefore, reducing lake levels during a dry period draws down the groundwater levels in the gravel aquifer on the lake shore resulting in cessation of artesian conditions. Drawdown of groundwater from the Lough Talt fen habitat resulting from the ongoing abstraction from Lough Talt has impacted upon the suitability of this fen habitat for *V. geyeri*. Continued and ongoing abstraction will further influence unsuitable conditions for *V. geyeri* at this location and will therefore not satisfy the Conservation Objective to restore this species conservation condition at Lough Hoe Bog SAC. Under these circumstances, the groundwater levels at the *V. geyeri* seepage zone may experience drawdown to the extent that groundwater may not be close enough to the surface to support the habitat that the snail and its floral and faunal community requires. As the snails are short-lived and cannot survive drying out for more than a short period (hours) (Falkner et al., 2001; Kuzskynska & Moorkens, 2010), such drawdown of groundwater can cause significant impacts to snail populations even during very short periods.

The conservation objectives assessment is provided in **Table 5.25** and defines the attributes, measures and targets for this species of Qualifying Interest.

Table 5.25: Conservation Objectives Assessment of Lough Hoe Bog SAC: [1013] Geyer's Whorl Snail (*Vertigo geyeri*)

Attribute	Measure	Target	Notes	Assessment
Distribution: occupied sites	Number of occupies 1km grid squares	Restore at least one sub-population	Geyer's whorl snail (*Vertigo geyeri*) has been recorded in two separate areas on the shore of Lough Talt in Lough Hoe Bog SAC within a single 1km square, G3915 (Cawley, 2006; site code VgCAM7 in Moorkens and Killeen, 2011). See map 4. The last record from the eastern side was in 2005. The current status of the population on the western shore is uncertain. The habitats occupied by	The species has not been recorded in Lough Talt since 2007 (**Appendix C, Table 3.2** Assessment of *V. geyeri* habitat at Lough Talt provides an overview of the molluscan species found in Lough Talt between 1997 and 2016). In the intervening 9 years, it is thought that during

Attribute	Measure	Target	Notes	Assessment
			Geyer's whorl snail (*V. geyeri*) in the SAC are areas of fen and flush close to the shore of Lough Talt.	droughts, the wet zone refuge areas have become too dry to support the species. Sustained abstraction for the operation of the WTP upgrade, during drought conditions is thought to exacerbate effects on the species over normal climatological fluctuations. Following the cessation of the raw water abstraction when the WTP is decommissioned and the replacement source is in place, the hydrological regime of the fen habitat will return to a more natural state.
Occurrence in suitable habitat	Number of positive records in a representative number of samples	No decline, subject to natural processes	Positive samples mean the confirmed presence of snails (living or recently dead adults and/or juveniles). See Moorkens and Killeen (2011).	Recent studies (Moorkens, 2016) suggest that the in spite of the current water abstraction regime, the fen habitat appears to be ideal for *Vertigo geyeri* and related fen spring-seepage specialist species, with the exception of the uppermost (PZ6) and the lowermost (PZ1) quadrats. At higher ground there appears to be too great a loss of connection with the groundwater to be ideal, and at low ground the rocky flatter ground results in poor resilience of habitat for specialist species that demand an even supply of water and humidity. Following the cessation of the raw
Habitat area	Hectares	Area of suitable habitat stable or increasing, subject to natural processes; at least 1ha of suitable habitat in at least sub-optimal condition	Apparently suitable conditions for the species are present at several places, with the largest area on the east shore of Lough Talt. Two less extensive areas are found on the west shore. Optimal habitat in the SAC is defined (by Moorkens and Killeen, 2011) as flushed fen grassland with sedge/moss lawns 5-15cm tall, containing species such as *Carex lepidocarpa, Pinguicula vulgaris, Briza media, Equisetum palustre, Juncus articulatus* and the mosses *Drepanocladus revolvens* and *Campylium stellatum*, with scattered tussocks of *Schoenus nigricans* no more than 80cm tall. During sampling, the water table should be between 0-5cm of the soil	

Attribute	Measure	Target	Notes	Assessment
			surface, but not above ground level. Sub-optimal habitat is defined as above, but vegetation height is less than 5 or more than 15cm tall, or the water table is below 5cm, or ground is flooded at time of sampling.	water abstraction when the WTP is decommissioned and the replacement source is in place, the hydrological regime of the fen habitat will return to a more natural state.
Habitat quality: soil wetness	Percentage of a representative number of sampling stops	At least 67% of a representative number of sampling stops in areas of optimal habitat should be classified as optimal wetness as defined by Moorkens and Killeen (2011); at least 25% should be optimal wetness in areas of sub-optimal habitat	The soil wetness should be assessed using the criteria described in Moorkens and Killeen (2011).	

5.4.2.2 Impact Assessment of Qualifying Habitats and Species of River Moy SAC

5.4.2.2.1 Atlantic Salmon (*Salmo salar)* - River Moy SAC

The drying out of the Eighnagh River for 39 days a year could cause a barrier to migration, however the stretch from the Lough Talt to approximately 300 meters downstream of the lake is of high gradient and generally unsuited to holding fish due to rapid currents, or for spawning fish due to the rocky substrate. It was considered that this high gradient stretch downstream of the lake could be naturally impassable to migrating salmonids; therefore this impact will not result in significant adverse effects to Atlantic Salmon.

The impact assessment on the conservation objectives for Atlantic Salmon associated with the River Moy SAC is presented in **Table 5.26**.

Table 5.26: Conservation Objectives Assessment of River Moy SAC: [1106] Salmon (*Salmo salar*)

Attribute	Measure	Target	Notes	Assessment
Distribution: extent of anadromy	% of river accessible	100% of river channels down to second order accessible from estuary	Artificial barriers block salmons' upstream migration, thereby limiting species to lower stretches and restricting access to spawning areas. There are no artificial barriers on the Moy catchment limiting	The Lough Talt RWSS WTP upgrade will not create barriers to migrating salmon to spawning grounds. The drying out of the Eighnagh River for 39 days a year could cause a

Attribute	Measure	Target	Notes	Assessment
			salmon access.	barrier to migration, however the stretch from the Lough Talt to approximately 300 meters downstream of the lake is of high gradient and generally unsuited to holding fish due to rapid currents, or for spawning fish due to the rocky substrate. It was considered that this high gradient stretch downstream of the lake could be naturally impassable to migrating salmonids.
Adult spawning fish	Number	Conservation Limit (CL) for each system consistently exceeded	The Moy is currently above its CL (SSCS, 2016[21]) and is consistently so.	
Salmon fry abundance	Number of fry/5 minutes electrofishing	Maintain or exceed 0+ fry mean catchment –wide abundance threshold value. Currently set at 17 salmon fry/ 5min sampling	The IFI surveyed three sites on the Moy River in 2010: at Cloonbaniff Bridge (two age classes 0+ and 1+ were present accounting for 48% and 52% of the total salmon catch respectively), at Bleanmore (three age classes 0+, 1+ and 2+ were present, accounting for approximately 4%, 88% and 8% of the total salmon catch respectively) and at the Ford 2km u/s of the Gweestion River (three age classes 0+, 1+ and 2+ were present, accounting for approximately 2%, 93% and 5% of the total salmon catch respectively).	Potential impacts from suspended sediment due to runoff of soil from the construction of the WTP upgrade can have severe negative impacts on all life stages of fish e.g. suspended sediment can settle on spawning areas, infill the intra-gravel voids and smother the eggs and alevins (newly hatched fish) in the gravel. The avoidance measures described in **Section 5.5** will minimise the generation of suspended solids laden surface water runoff in the first instance.
Out-migrating smolt abundance	Number	No significant decline	Smolt abundance can be negatively affected by a number of impacts such as estuarine pollution, predation and sea lice (*Lepeophtheirus salmonis*)	
Number and distribution of redds	Number and occurrence	No decline in number and distribution of spawning redds dues to anthropogenic causes	Salmon spawn in clean gravels. There are no artificial barriers preventing salmon from accessing suitable spawning habitat in this SAC	
Water	EPA Q value	At least Q4 at all	Water quality in the Lough	

21 http://www.fisheriesireland.ie/fisheries-management-1/salmon/639-the-status-of-irish-salmon-stocks-in-2015-with-precautionary-catch-advice-for-2016

Attribute	Measure	Target	Notes	Assessment
Quality		sites sampled by EPA	Talt / Eighnagh River is currently Q4-5 or at high status and therefore exceeding this requirement.	

5.4.2.2.2 Lamprey - River Moy SAC

The drying out of the Eighnagh River for 39 days a year could cause a barrier to migration, however the stretch from the Lough Talt to approximately 300 meters downstream of the lake is of high gradient and does not provides suitable habitat for Lamprey, therefore this impact will not result in significant adverse effects to Atlantic Salmon.

The impact assessment on the conservation objectives for Brook Lamprey associated with the River Moy SAC is presented in **Table 5.27.**

Table 5.27: Conservation Objectives Assessment of River Moy SAC: [1096] Brook Lamprey (*Lampetra planeri*)

Attribute	Measure	Target	Notes	Assessment
Distribution	Percentage of river accessible	Access to all water courses down to first order streams	Artificial barriers can block lampreys' migration both up and downstream, thereby possibly limiting species to specific stretches, restricting access to spawning areas and creating genetically isolated populations (Espanhol et al., 2007). However, there are no artificial barriers in the Moy catchment limiting lamprey access.	The Lough Talt RWSS WTP upgrade will not create barriers to migrating lamprey to spawning grounds. The drying out of the Eighnagh River for 39 days a year may cause a barrier to migration; however the upper reaches of the Eighnagh River does not provides suitable habitat for Lamprey.
Population structure of juveniles	Number of age/size groups	At least three age/size groups of brook/river lamprey present	Attribute and target based on data from Harvey and Cowx (2003). It is impossible to distinguish between brook and river lamprey juveniles in the field (Gardiner, 2003); hence they are considered together in this target.	
Juvenile density in fine sediment	Juveniles/m^2	Mean catchment juvenile density of brook/river lamprey at least $2/m^2$	Juveniles burrow in areas of fine sediment in still water. Attribute and target based on data from Harvey and Cowx (2003) who state $10/m^2$ in optimal conditions and more than $2/m^2$ on a catchment basis.	Potential impacts from suspended sediment due to runoff of soil from the construction of the WTP upgrade can have severe negative impacts on all life stages of fish e.g. suspended sediment can settle on spawning areas,
Extent and distribution of spawning habitat	m^2 and occurrence	No decline in extent and distribution of spawning beds	Attribute and target based on spawning bed mapping by Inland Fisheries Ireland (IFI). Lampreys spawn in clean	

Attribute	Measure	Target	Notes	Assessment
			gravels.	infill the intra-gravel voids and smother the eggs and alevins (newly hatched fish) in the gravel. The avoidance measures described in **Section 5.5** will minimise the generation of suspended solids laden surface water runoff in the first instance.
Availability of juvenile habitat	Number of positive sites in 2nd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive	Silting habitat is essential for larval lamprey and they can be severely impacted by sediment removal. Recovery can be rapid and newly-created habitat can be rapidly colonised (King et al., 2015). However, it is vital that such sedimenting habitats are retained. Occupancy in excess of 50% of sites would be 'reasonable' for the Irish catchments examined to date. (King and Linnane, 2004; King et al., unpublished data).	

5.4.2.2.3 Otter (*Lutra lutra*) - River Moy SAC

Water quantity is important to otters, especially where low flows (in rivers) reduce the food base, namely fish (Mason, 1995). However, otter are a highly mobile species and due to the abundance of habitat within Lough Talt and downstream of the confluence of the Eighnagh and Lough Hoe River within the Moy catchment, it is likely that impacts to otter are temporary and will not result in significant adverse effects to the species in view of its conservation objectives.

The impact assessment on the conservation objectives for Otter associated with the River Moy SAC is presented in **Table 5.28.**

Table 5.28: Conservation Objectives Assessment of River Moy SAC: [1355] Otter (*Lutra lutra*)

Attribute	Measure	Target	Notes	Assessment
Distribution	Percentage positive survey sites	No significant decline	Measure based on standard otter survey technique. FCS target, based on 1980/81 survey findings, is 88% in SACs. Current range is estimated at 93.6% (Reid et al., 2013)	Otter are noted to be widespread throughout the SAC system (NPWS, 2014) and in and around the Lough Talt waterbody itself through means of spraint records.
Extent of terrestrial habitat	Hectares	No significant decline. Area mapped and calculated as 1068.8ha	No field survey. Areas mapped to include 10m terrestrial buffer along lake shorelines and along river banks identified as critical for otters (NPWS, 2007)	No significant decline of terrestrial habitat is anticipated from the proposed works. This is due to the nature of the works being proposed within the footprint of the existing Water Supply Scheme property.
Extent of freshwater (river) habitat	Kilometres	No significant decline. Length mapped and	No field survey. River length calculated on the basis that otters will utilise freshwater habitats from	No significant decline of freshwater (river) habitat is anticipated from the proposed works.

Attribute	Measure	Target	Notes	Assessment
		calculated as 479.4km	estuary to headwaters (Chapman and Chapman, 1982)	
Extent of freshwater (lake) habitat	Hectares	No significant decline. Area mapped and calculated as 1248.2ha.	No field survey. Area mapped based on evidence that otters tend to forage within 80m of the shoreline (NPWS, 2007)	The construction phase and abstraction activities could potentially result in a reduction of species density for Otter. However, with best practice and guidance measures being adhered to, it is not anticipated that that the freshwater habitat extent will be impacted with regards to otter.
Couching sites and holts	Number	No significant decline	Otters need lying up areas throughout their territory where they are secure from disturbance (Kruuk, 2006; Kruuk and Moorhouse, 1991)	No significant decline of habitat is anticipated from the proposed works. This is due to the nature of the works being proposed within the footprint of the existing Water Supply Scheme property and not the River itself in any way that would cause a reduction in couching site or holt potential.
Fish biomass available	Kilograms	No significant decline	Broad diet that varies locally and seasonally, but dominated by fish, in particular salmonids, eels and sticklebacks in freshwater (Bailey and Rochford, 2006; Reid et al., 2013)	There is evidence that the Eighnagh River runs dry in drought conditions. However, due to the abundance of habitat within Lough Talt and downstream of the confluence of the Eighnagh and Lough Hoe River, it is unlikely that this has significant implications for Otter foraging grounds within the Eighnagh River during drought occurrences.
Barriers to connectivity	Number	No significant increase. For guidance, see Map 8.	Otters will regularly commute across stretches of open water up to 500m e.g. between the mainland and an island; between two islands; across an estuary (De Jongh and O'Neill, 2010). It is important that such commuting routes are not obstructed	Implementation of best practice measures and guidance is expected to avoid any impacts that may affect barriers to connectivity for otter. The design proposed is for all abstraction equipment will be sub-surface within the existing road network and therefore will not pose as any barriers to connectivity for otter.

5.4.2.2.4 White-clawed Crayfish (Austropotamobius pallipes)

Under the existing rate of abstraction of 8 MLD condition, during dry periods, the Eighnagh River dries out between the outflow from the lake to the river to its confluence with the Lough Hoe River

300m downstream. There are indications that there is no flow from Lough Talt for 39 days of an average year in the upper 300m of the Eighnagh River, see **Section 5.1.2.2**.

White-clawed crayfish may be affected during these periods through barriers to migration, loss of refugia and foraging grounds. Low water levels caused by natural droughts or over-abstraction can be devastating to local crayfish populations, increasing their vulnerability to predation. This may have a significant impact on local crayfish populations through the reduction in the availability of suitable habitat within the river during drought occurrences.

The impact assessment on the conservation objectives for White-clawed Crayfish associated with the River Moy SAC is presented in **Table 5.29.**

Table 5.29: Conservation Objectives Assessment of River Moy SAC: [1092] White-clawed Crayfish (*Austropotamobius pallipes*)

Attribute	Measure	Target	Notes	Assessment
Distribution	Occurrence	No reduction from baseline	The general distribution of white-clawed crayfish in the River Moy SAC is that it is widespread in the upper tributaries of the River Moy and the rivers which feed Loughs Conn and Cullin. It is absent from the main River Moy. Lough Talt supports a good population of white-clawed crayfish	The Eighnagh River (a tributary of the River Moy) was surveyed on a number of occasions by Ecofact 2010 and 2016. Crayfish were found in all locations surveyed on the Eighnagh River. There is evidence that the Eighnagh River runs dry in drought conditions. Crayfish can be found in shallow riffles and in streams less than 0.5 m wide with just a few centimetres of water (Rogers & Holdich 1995). However, low water levels caused by natural droughts or over-abstraction can be devastating to local crayfish populations, increasing their vulnerability to predation. This may reduce the availability of suitable habitat and population structure within the river for the species during drought occurrences for the duration of the operation of the WTP upgrade. The cessation of water abstraction during the decommissioning stage will affect surface water regime of the river outflow and will consequently result in a positive effect on the water dependent species of the River Moy SAC as naturally occurring drought conditions will not be exacerbated by the abstraction of 8MLD, and it is unlikely that the Eighnagh River will dry out annually thereby providing more habitat White-
Population structure: recruitment	Percentage occurrence of juveniles and females with eggs	Juveniles and/or females with eggs in at least 50% of positive samples	See Reynolds et al. (2010) for further details	

Attribute	Measure	Target	Notes	Assessment
				clawed Crayfish during drought conditions.
Negative indicator species	Occurrence	No alien crayfish species	Alien crayfish species are identified as a major direct threat to this species and as a disease vector. See Reynolds (1998) for further details. Ireland is currently free of non-native invasive crayfish species	The surveys conducted to date did not show any results that indicated the presence of alien crayfish species. However, any future surveys or mitigation activities will be conducted in accordance with strict biosecurity measures, as outlined in the guidance of the Inland fisheries Ireland Biosecurity Protocol for Field Survey Work (2011) to ensure no negative impacts are caused to other watercourses. http://www.fisheriesireland.ie/fisheries-research-1/73-biosecurity-protocol-for-field-survey-work-1
Disease	Occurrence	No instances of disease	Crayfish plague is identified as major threat and has occurred in Ireland even in the absence of alien vectors. See Reynolds (1998) for further details. Disease can in some circumstances be introduced through contaminated equipment and water in the absence of vector species	No indications of disease were found within the population surveyed as part of the Ecofact 2016 surveys. However, any future surveys or maintenance activities will be conducted in accordance with strict biosecurity measures, as outlined in the guidance of the Inland fisheries Ireland Biosecurity Protocol for Field Survey Work (2011) to ensure no negative impacts are caused to other watercourses. http://www.fisheriesireland.ie/fisheries-research-1/73-biosecurity-protocol-for-field-survey-work-1 Any instances of the disease will be reported to the IFI and NPWS
Water quality	EPA Q value	At least Q3-4 at all sites sampled by EPA	Target taken from Demers and Reynolds (2002) and equivalent to moderate status under the WFD classification scheme. Q values based on triennial water quality surveys carried out by the EPA	Lake Waterbody WFD Status 2013-2015 indicate that Lough Talt is of *Good* status.
Habitat quality: heterogeneity	Occurrence of positive habitat features	No decline in heterogeneity or habitat quality	Crayfish need high habitat heterogeneity. Larger crayfish must have stones to hide under, or an earthen bank in which to burrow. Hatchlings shelter in vegetation, gravel and among fine tree-roots.	The drying out of the Eighnagh River during drought conditions may affect the heterogeneity of suitable habitat for this species.

Attribute	Measure	Target	Notes	Assessment
			Smaller crayfish are typically found among weed and debris in shallow water. Larger juveniles in particular may also be found among cobbles and detritus such as leaf litter. These conditions must be available on the whole length of occupied habitat	

There are indications that there is no flow from Lough Talt to the Eighnagh River for 39 days of an average year. White-clawed crayfish may be affected during these periods through barriers to migration, loss of refugia and foraging grounds. Low water levels caused by natural droughts or over-abstraction can be devastating to local crayfish populations, increasing their vulnerability to predation. This may have a significant impact on local crayfish populations through the reduction in the availability of suitable habitat within the river during drought occurrences while also impacting on the connectivity between Lough Talt and the Eighnagh River. Given that it is also unknown what level of significance this occurrence may be having on the overall population dynamics of the white-clawed crayfish within the River Moy SAC, it has been determined, using the precautionary principle, to provide mitigation measures for the translocation of the species, given that lowering the abstraction volumes from Lough Talt is not a viable option.

5.4.2.2.5 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alion incanae, Salicion albae) – River Moy SAC

The Annex I habitat Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) [91E0] comprises woods dominated by alder *Alnus glutinosa* and willow *Salix* spp. on flood plains in a range of situations from islands in river channels to low-lying wetlands alongside the channels. The habitat typically occurs on moderately base-rich, eutrophic soils subject to periodic inundation. Periodic flooding is essential to maintain alluvial woodlands along river floodplains and lakeshores. This habitat is found on the western shores of Lough Conn within the SAC, but may be found elsewhere in the Moy catchment. The Eighnagh River is the outflowing river from Lough Talt and is a tributary of the River Moy. The Lough Talt catchment amounts to approximately 1.87% of the total Moy catchment and the Lough Talt catchment accounts for approximately 0.73% of the median (50%) flow of the River. Based on the size of the Moy catchment the drying out of the Eighnagh River for 39 days is unlikely to cause a significant change to the hydrological regime of the Moy catchment downstream, therefore significant change to the hydrological regime of this habitat is not expected.

The impact assessment on the conservation objectives for Alluvial Woodlands associated with the River Moy SAC is presented in **Table 5.30.**

Table 5.30: Conservation Objectives Assessment of River Moy SAC: [91E0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alion incanae, Salicion albae*)

Attribute	Measure	Target	Notes	Assessment
Habitat Area	Hectares	No reduction from baseline	Total extent of this habitat within the SAC is unknown and it may occur in mosaics with other woodland types. Two sites (1763, 1800) within the SAC were surveyed as part of the National Survey of Native Woodlands (NSNW) (Perrin et al., 2008). Map 6 shows surveyed woodlands including areas classified as 91E0 (2.76ha). NB areas mapped as other wet woodland types may also correspond with this Annex I woodland type. There are also likely to be additional areas of this Annex I woodland type within the SAC	This habitat has been recorded within the SAC on the western shore of Lough Conn, however there, there are also likely to be additional areas of this Annex I woodland type within the SAC. This habitat was not recorded in proximity to the WTP upgrade or on the banks of the Eighnagh River. There will be no direct loss of this habitat.
Habitat Distribution	Occurrence	No decline. Woodlands surveyed as part of the NSNW are shown on map 6	The area of this habitat identified by the NSNW occurs at Prospect (site 1800) on the western shore of Lough Conn. See note on area above	There will be no direct loss of this habitat.
Woodland size	Hectares	Area stable or increasing. Where topographically possible, "large" woods at least 25ha in size and “small” woods at least 3ha in size	The sizes of at least some of the existing woodlands need to be increased in order to reduce habitat fragmentation and benefit those species requiring ‘deep’ woodland conditions (Peterken, 2002). Topographical and land-ownership constraints may restrict expansion	There will be no direct loss of this habitat.
Woodland structure: cover and height	Percentage and metres	Diverse structure with a relatively closed canopy containing mature trees; subcanopy layer with semi-mature trees and shrubs; and well-developed herb layer	Described in Perrin et al. (2008)	There will be no direct loss of this habitat.
Woodland structure:	Hectares	Maintain diversity and	Described in Perrin et al. (2008)	There will be no direct loss of this habitat.

Attribute	Measure	Target	Notes	Assessment
community diversity and extent		extent of community types		
Woodland structure: natural regeneration	Seedling: sapling: pole ratio	Seedlings, saplings and pole age-classes occur in adequate proportions to ensure survival of woodland canopy	Alder (*Alnus glutinosa*) and oak (*Quercus* spp.) regenerate poorly. Ash (*Fraxinus excelsior*) often regenerates in large numbers although few seedlings reach pole size	There will be no direct loss of this habitat.
Hydrological regime: Flooding depth/height of water table	Metres	Appropriate hydrological regime necessary for maintenance of alluvial vegetation	Periodic flooding is essential to maintain alluvial woodlands along river floodplains and lakeshores	The Eighnagh River is the outflowing river from Lough Talt and is a tributary of the River Moy. Lough Talt catchment amounts to approximately 1.87% of the total Moy catchment and the Lough Talt catchment accounts for approximately 0.73% of the median (50%) flow of the River. The habitat is found on the western shore of Lough Conn within the SAC, however there, there are also likely to be additional areas of this Annex I woodland type within the SAC. Based on the size of the Moy catchment the drying out of the Eighnagh River for 39 days is unlikely to cause a significant change to the hydrological regime of the Moy catchment downstream. No significant change to the hydrological regime of this habitat is expected.
Woodland Structure: veteran trees	Number per hectare	No decline	Mature and veteran trees are important habitats for bryophytes, lichens, saproxylic organisms and some bird species. Their retention is important to ensure continuity of habitats/niches and propagule sources	There will be no direct loss of this habitat.
Woodland	Occurrence	No decline	Includes ancient or long-	There will be no impacts

Attribute	Measure	Target	Notes	Assessment
structure: indicators of local distinctiveness			established woodlands, archaeological and geological features as well as red-data and other rare or localised species	to the habitat in this respect.
Vegetation composition: native tree cover	Percentage	No decline. Native tree cover not less than 95%	Species reported in Perrin et al. (2008)	Potential impacts from suspended sediment of pollutants during the construction stage of the WTP upgrade may impact the nutrient loading to the River Moy and by extension to the alluvial woodlands impacting species diversity. The avoidance measures described in **Section 5.5** will minimise the generation of suspended solids laden surface water runoff in the first instance.
Vegetation composition: typical species	Occurrence	A variety of typical native species present, depending on woodland type, including alder (*Alnus glutinosa*), willows (*Salix* spp.), oak (*Quercus robur*) and ash (*Fraxinus excelsior*)	Species reported in Perrin et al. (2008)	
Vegetation composition: negative indicator species	Occurrence	Negative indicator species, particularly non-native invasive species, absent or under control	The following are the most common invasive species in this woodland type: sycamore (*Acer pseudoplatanus*) and Himalayan balsam (*Impatiens glandulifera*). The NSNW notes rhododendron (*Rhododendron ponticum*) clearance in site 1800	

5.4.3 Cumulative Impacts with Other Plans and Projects in the Area

An assessment on the Potential In-Combination Effects of Other Plans and Projects was undertaken as part of the Screening for AA in **Table 4.3**.

5.4.4 Conclusion of Impact Assessment

All possible sources of effects from the Lough Talt RWSS WTP upgrade, together with all other sources in the existing environment and any other effects likely to arise from other proposed plans or projects have been identified. Potential impacts to the qualifying interests of Lough Hoe Bog SAC and the River Moy SAC have been identified as a result of effects resulting in the operation of the WTP upgrade, see **Table 5.31**.

Table 5.31: Potential In-Combination Effects of Other Plans and Projects

Feature		Construction Stage Impacts		Operation Stage Impact		Decommissioning Stage Impact		Cumulative Impacts
Qualifying Interest	**Conservation Status (Overall Trend)**	**Direct**	**Indirect**	**Direct**	**Indirect**	**Direct**	**Indirect**	
Lough Hoe Bog SAC (000633)								
[1013] Geyer's Whorl Snail (*Vertigo geyeri*)	Declining	No impact	No impact	No impact	*V. geyeri* was first recorded at Lough Talt in 1992. The species was found to be plentiful when the survey was repeated in 2007. In 2008, the transect was repeated (E. Moorkens), but *V. geyeri* were not found during that survey, nor have the species been found in subsequent surveys undertaken between 2010 and 2016. The possible cause of loss of *V. geyeri* over the last 9 years has been identified as a severe low water deficit during drought conditions. The current lake abstraction operation results in the lake level dropping below a critical level to sustain the habitat on an annual basis during dry weather. The continued abstraction from the lake when the water level drops below this elevation has an impact on the artesian conditions within the fen,	The cessation of the abstraction of 8,000MLD from Lough Talt will potentially increase the levels in the lake as well as the discharge from the lake to the Eighnagh River temporarily. The outflow to the river is proportional to the lake level so the cessation of the abstraction will initially lead to a slight increase in lake levels but ultimately will lead to increased outflows from the lake. No impact expected.	The hydrological regime of the fen habitat will return to a more natural state.	Abstraction from groundwater higher up in the catchment may also be affecting the hydraulic head within the fen.

Feature		Construction Stage Impacts		Operation Stage Impact		Decommissioning Stage Impact		Cumulative Impacts
					which are the supporting conditions for the habitat.			
[1092] White-clawed Crayfish (*Austropotamobius pallipes*)	Stable	No impact	Potential impact from water pollution	No impact	No Impact	No Impact	The cessation of water abstraction during the decommissioning stage would return the hydrological regime of the lake to a more natural state thereby providing more habitat for aquatic species in the littoral zone.	Potential in-combination effects from siltation and nutrient enrichment from external sources
River Moy SAC (002298)								
[1092] White-clawed Crayfish (*Austropotamobius pallipes*)	Stable	No impact	Potential impact from water pollution	No impact	White-clawed crayfish may be affected during drought events in the 300m of the Eighnagh River between Lough Talt and the confluence with the Lough Hoe River.	No impact	The cessation of water abstraction during the decommissioning stage would return the hydrological regime of the Eighnagh to pre-abstraction conditions and it is unlikely that the River will dry out annually thereby providing more habitat for aquatic species during drought conditions.	None identified
[1096] Brook	Stable	No	Potential	No impact	No impact	No impact	No Impact	None

Feature		Construction Stage Impacts		Operation Stage Impact		Decommissioning Stage Impact		Cumulative Impacts
Lamprey (*Lampetra planeri*)		impact	impacts from suspended sediment due to runoff of soil from the construction of the WTP upgrade can have severe negative impacts on all life stages of fish					identified
[1106] Salmon (*Salmo salar*)	Stable	No impact		No impact	No impact	No impact	No Impact	None identified
[1355] Otter (*Lutra lutra*)	Stable	No impact	Potential impacts through disturbance and water pollution during the construction stage	No impact	No impact	No impact	No Impact	None identified
[91E0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alion incanae, Salicion albae)	Improving	No impact	No impact	No impact	No impact	No impact	No Impact	None identified

5.5 BEST PRACTICE DESIGN AND CONSTRUCTION METHODOLOGY / MITIGATION

5.5.1 Mitigation during the Construction Stage

There will be no impacts to the integrity of Lough Hoe Bog during the construction stage of the Lough Talt RWSS WTP upgrade.

Indirect impacts during the construction stage of the Lough Talt RWSS WTP upgrade to the qualifying interests of the River Moy SAC have been identified and include the Annex II species White-clawed Crayfish (*Austropotamobius pallipes*) [1092], Brook Lamprey (*Lampetra planeri*) [1096], Salmon (*Salmo salar*) [1106] and Otter (Lutra lutra) [1355]. Robust and effective mitigation measures have been proposed in the following sections to avoid or ameliorate these impacts.

5.5.2 Best Practice Design and Construction Methodology

The proposed works will be carried out by contractors, suitably appointed through a tendering process, who can meet the requirements of the standard best practice measures outlined below. A CEMP **(Appendix F)** has been prepared for this project and includes an Environmental Method Statement. This document outlines how the proposed works will be conducted and how these methods will avoid all potential impacts to proximal and nearby European sites. The measures required for inclusion in the CEMP to be prepared for the WTP upgrade construction, operation and decommissioning stages are discussed in greater detail below.

5.5.2.1 Measures Included in Construction Environmental Management Plan (CEMP) and Environmental Method Statements (EMS)

The following best practice measures will be included and incorporated into the appointed contractor's CEMP and EMS:

1. All refuelling of machinery will take place within the construction compound[22]. All fuels, oils, lubricants etc. will be bunded to 110% capacity and stored within the site's construction compound,
2. Wash-down water from exposed surfaces, will be trapped to allow sediment to settle out and reach neutral pH before clarified water is released to the drain system or allowed to percolate into the ground,
3. Raw or uncured waste concrete will be disposed of by removal from the site,
4. Any spillage of fuels, lubricants of hydraulic oils will be immediately contained and the contaminated soil removed from the site and properly disposed of,
5. Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or re-cycling,
6. All maintenance operators will carry out their works under the guidance of the Inland fisheries Ireland Biosecurity Protocol for Field Survey Work (2011) to ensure no negative impacts are

[22] The location of the construction compound will be located on gently sloping ground at least 50 m from on-site watercourses and drainage channels within or immediately adjacent to the proposed Water Treatment Site.

caused to other watercourses. http://www.fisheriesireland.ie/fisheries-research-1/73-biosecurity-protocol-for-field-survey-work-1,

7. Where fill material is required, it will be recovered and reused from any excavations within the site. The importation of foreign material will be sourced from the same parent material as that found on site. In addition, the source of imported fill material will be checked for invasive plant species before use;
8. Unsuitable construction material arising on site will be transported off site to a licensed waste facility; and
9. Release of suspended solids to all surface waters (including drainage channels) will be controlled by interception (e.g. silt traps) and management of site run-off. Any surface water run-off will be treated appropriately to ensure that suspended solids levels are minimised. Suitable precautions will also be taken to ensure that oil, and other polluting materials associated with construction sites, does not enter channels draining the site.

The following guidelines and documents will be consulted during the detailed planning of the works phase and the preparation of the site and project specific tasks. These documents will also inform best practice and construction design methodologies outlined in the CEMP and EMS:

1. Good practice guidelines on the control of water pollution from construction sites developed by the Construction Industry Research and Information Association (CIRIA) in particular,
   - C532 *Control of water pollution from construction sites: guidance for consultants and contractors* (Masters-Williams *et al*, 2001); and
   - SP156 *Control of water pollution from construction sites – guide to good practice* (Murnane *et al*, 2002).
2. Series of Ecological Assessments on Arterial Drainage Maintenance No.10. Ecological Impact Assessment (EcIA) of the Effects of Statutory Arterial Drainage Maintenance Activities on White-clawed Crayfish (*Austropotamobius pallipes*) http://www.opw.ie/media/Issue%20No.%2010%20EcIA%20White-clawed%20Crayfish.pdf
3. NRA (2008) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. National Roads Authority, Dublin,
4. NRA (2010) Guidelines for the Management of Noxious Weeds and Non- Native Invasive Plant Species on National Roads. National Roads Authority, Dublin,
5. Murphy, D. (2004) Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites. Eastern Regional Fisheries Board, Dublin, and
6. DOMNR (1998). Fishery guidelines for Local Authority works. Department of the Marine and Natural Resources, Dublin.

The proposed WTP upgrade supports connectivity to the Eighnagh River via the sites drainage channels and through overland flow. The Eighnagh River is designated as part of the River Moy SAC. This connectivity represents the main vector and impact source associated with the proposed construction of the WTP upgrade. Therefore the construction should be designed and completed in such a way to retain all potential pollutant sources emanating from the site via its drainage channels.

The publication '*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites*' (Murphy, 2004) and the NRA's '*Guidelines for the crossing of watercourses during the construction of national road schemes*' (NRA, 2008) will also inform those construction practices used during the construction period.

Construction of the proposed WTP upgrade will be informed by the CEMP. The measures outlined in the CEMP will seek to avoid the release of deleterious substances associated with all aspects of the project's construction phase. Chapter 5 of the CEMP details how these best practice and mitigation measures will be monitored for effectiveness including details of the response strategy and chain of command immediately following or during a pollution event.

5.5.2.2 Construction Phase Best Practice Measures

The below Best Practice Measures will be included in the CEMP and EMS for the proposed WTP upgrade.

5.5.2.3 Control of Airborne Pollutants during Construction Activities

To protect sensitive receptors in the vicinity of the scheme the following measures are proposed. Measures to mitigate the emission of dust due to construction activities include:

- Wind breaks and barriers,
- Control of vehicle access,
- Vehicle speed restrictions,
- Bed of gravel at site exit points to remove caked on dirt from tyres and tracks,
- Washing of equipment at the end of each work day,
- Prevention of on-site burning,
- Hard surface roads should be wet swept to remove any deposited materials,
- Unsurfaced roads should be restricted to essential site traffic only, and
- Wheel-washing facilities should be located at all exits from the construction site.

5.5.2.4 Excavated Material

Aggregate material and soils excavated as part of the proposed construction works will be retained to within the footprint of the proposed WTP upgrade (where possible). To this end, it is proposed to incorporate the excavated parent material as part of the landscape design (where suitable for such works) or to utilise excess excavated material for screening purposes. If feasible, excess excavated material may be used to form a screening berm along the site's southern boundary. To ensure the stability of the berm, all peat and unsuitable soft soils below the proposed perimeter berm will be excavated and replaced with acceptable Class 6A or 1C granular engineering fill in accordance with NRA (TII) Specification for Road Works. The berm will be hydro-seeded and landscaped with a species composition found in the locality. Any excess material will be disposed of off-site at a licensed facility.

5.5.2.5 Concrete and Cement

Wet concrete and cement are very alkaline and corrosive and can cause serious pollution to watercourses. The following precautions will be put in place with regard to Concrete and Cement:

- Disposal of raw or uncured waste concrete must be controlled to ensure that the drainage channels or receiving watercourse (Eighnagh River) will not be impacted,

- Best practice in bulk-liquid concrete management addressing pouring and handling, secure shuttering / form-work, adequate curing times,
- Where shuttering is used, measures should be put in place to prevent against shutter failure and control storage, handling and disposal of shutter oils,
- Wash water from cleaning ready mix concrete lorries and mixers may be contaminated with cement and is therefore highly alkaline. Due to the size of the site and the proximity of sensitive watercourses, lorries and mixers will be washed out off site, and
- Cement dust must be controlled as it is alkaline and harmful to the surrounding ecology. Activities which result in the creation of cement dust must be controlled by dampening down areas.

5.5.2.6 Fill material

The rock type underlying much of the site is schist, a coarse grained metamorphic, siliceous rock. Where fill material is required, it should be recovered and reused from any excavations within the site. The importation of foreign material should be limited, however if it is required it should be the same rock type as found on site; i.e. siliceous material. The source locations for imported fill will be assessed for invasive species prior to delivery to site. See **Section 5.5.2.10** below.

5.5.2.7 Hydrocarbons

Fuel and hydraulic fluids will be stored within a designated site compound. Refuelling will only take place in the site compound. All stationary plant will be placed on drip trays to prevent leaking oils reaching the river or entering groundwater.

No washings or waste materials of any kind will be directed into the site's drainage channels. Machinery on site will have pollution control kits on hand in the event of an emergency.

5.5.2.8 Construction waste

All construction related waste, e.g. plastics, cable ties, geotextile etc. will be collected and disposed of correctly so that they don't enter the site's drainage channels.

5.5.2.9 Reduction and Prevention of Suspended Solids Pollution

As the site is hydrologically connected to the River Moy SAC via onsite drainage channels and overland flow, measures will be put in place to ensure that no significant impact on the River Moy SAC is caused following the release of suspended solids or other deleterious materials.

The proposed construction of the WTP upgrade will require mitigation measures to prevent contamination of the site's drainage channels and by extension the Eighnagh River with debris, suspended solids and other pollutants. This will require that all particulate material is prevented from entering the river.

During the project construction phase, surface water drainage will be directed (via overland flow) and collected within a catch-all swale paralleling the site's southern boundary. The collected water will then be directed to a sediment basin and control pit for attenuation. Once sufficiently settled, the collected water will be released via a rock spillway to the drainage channel on the sites southern boundary (See **Appendix A**).

During the project operational phase, all surface water will be positively drained via the site's storm sewer designed to drain all hard standing areas. All surface water falling on the proposed WTP hard standing areas will be directed to a Class 1 bypass petrol interceptor near the sites south-eastern boundary. From here, the collected water will be passed to an attenuation tank near the site's south-eastern boundary, thereafter, the settled water will outfall from the attenuation tank to the existing drain along the site's southern boundary at Greenfield run-off rates (See **Appendix A**).

The key factors in erosion and sediment control for land based works are to intercept and manage runoff at source. This limits the potential for soils to be eroded before entering watercourses through overland runoff. The following general guidelines for erosion and sediment control which are to be adhered to during the construction of the proposed WTP are largely based on Goldman *et al.,* (1986):

i. Construction shall be halted during periods of heavy precipitation and run-off to minimise soil disturbance,
ii. Stockpile areas of soil and aggregate material will not be stored to within 30 metres of the drainage channels draining the site,
iii. Silt fencing shall be installed along the perimeter of the on-site drainage channels to retain eroded or liberated sediments,
iv. No machinery shall be allowed to enter or cross the site's drainage channels.

5.5.2.10 Invasive Species

The source locations for materials (aggregate, fill or other) which are introduced to the site during the construction phase of the project will be free from non-native invasive species. The site walkover surveys completed in support of this report did not identify invasive species within the bounds of the proposed WTP upgrade, the existing WTP or those areas surrounding or intersecting either area.

5.5.2.11 Efficacy of Best Practice Measures

The best practice measures provided in this section are based on domestic and internationally recognised guidance documents that underpin ecological mitigation prescribed for the majority of small and large scale projects completed in Ireland today. Furthermore, the appointed contractor will construct the proposed WTP upgrade under the auspices of a CEMP, which is informed by those best practice measures outlined in this section. In addition, the successful implementation of the CEMP will be monitored for effectiveness by an Environmental Officer (EO) throughout the duration of the project construction (See **Section 1.2.6** of the CEMP). The EO will monitor site operations and audit the Contractor's operations throughout the construction phase of the project. Therefore, a system will be set in place throughout the project's construction, operation and decommissioning phases to monitor, report and act on the efficacy of the various mitigation measures proposed.

Such a dynamic will allow for the efficient and effective implementation of those best practice and construction design methodologies for the proposed WTP upgrade.

Avoiding, controlling and managing sediment loss from the site during the project construction phase is considered to be the primary issue in terms of mitigating potential effects on nature conservation locally and the River Moy SAC. The construction design, best practice and mitigation measures have been created to address potential release of fine sediments and other potential pollutants during the construction of the proposed WTP upgrade. The release of particulate matter and other pollutants in solution via overland flow and via the site's drainage system represents the greatest impact source to the River Moy SAC.

Details of the approach to attenuate sediment laden water generated during the project construction phase have been prepared and outlined as part of this assessment (**Section 5.5.2.9**). Following the implementation of these prescribed best practice and mitigation measures, residual impacts to the River Moy SAC associated with the proposed WTP upgrade will be neutral.

The implementation of those mitigation and best practice measures detailed in this assessment and informing the CEMP prepared for this development will negate all potential pollutant sources from leaving the proposed WTP upgrade site and entering those proximal areas of the River Moy SAC. In addition, details on the WTP operational procedures to recirculate all washwaters, by-product water and all other by-products have been outlined in **Section 3.2.4** of this assessment.

5.5.3 Operational Phase Mitigation

5.5.3.1 Hydrological Mitigation Measures for *Vertigo geyeri*

A hydrogeological assessment (RPS, 2016) concluded that water abstraction from Lough Talt during extended dry periods results in decreased groundwater levels within the fen, leading to a loss of supporting habitat conditions for Geyer's whorl snail (*Vertigo geyeri*). Optimal and sub-optimal habitat conditions for the species are present at several places around Lough Talt, with the largest area on the east shore of Lough Talt. Two less extensive sub-optimal habitat areas are found on the west shore. It is not possible to improve the habitat condition and suitability due to the size and location of these habitats and the limited active seepage zones in these areas.

Therefore, mitigation measures are proposed to counteract the impacts to the rich fen habitat on the north-west shores of Lough Talt to provide suitable habitat for *V. geyeri* populations to exist and subsequently thrive.

5.5.3.1.1 Background

Various hydrogeological investigations have previously been completed at the Lough Talt fen habitat and a number of boreholes and piezometers (or phreatic tubes) have been installed within the area, as illustrated in **Figure 5-10**.

Previous hydrogeological studies completed at Lough Talt are presented in the following documents:

- RPS (2013) Lough Talt Hydrogeological Impact Assessment Report (RPS Ref No.i143/D1/003a) Unpublished Consultants Report.
    - This report provides details of a hydrogeological investigation programme completed to assess linkages between lake levels and the groundwater flushes that support the fen habitat. The report provides details of a site investigation programme completed (including the drilling, installation and hydraulic testing

of five boreholes and six phreatic tubes/piezometers), development of a conceptual hydrogeological model for the area, and analysis of groundwater and surface water level monitoring data with regards to establishing the inter-relationship between lake levels and groundwater levels.

- RPS (2016) Lough Talt Hydrogeological Impact Assessment Report (RPS Ref No.i143/G1/009a) Unpublished Consultants Report.
  - This report provides details of the additional groundwater and lake level monitoring data (gathered between 2013 and 2016), development of a water balance model to assist with lake abstraction management and the establishment of lake level trigger values.
- RPS (2018) Lough Talt Hydrogeological Impact Assessment Addendum, Site Visit & Data Review (RPS Ref No.EWD72642.001/102a) Unpublished Consultants Report.
  - This report provides details of the additional groundwater and lake level data gathered between 2016 and January 2018.

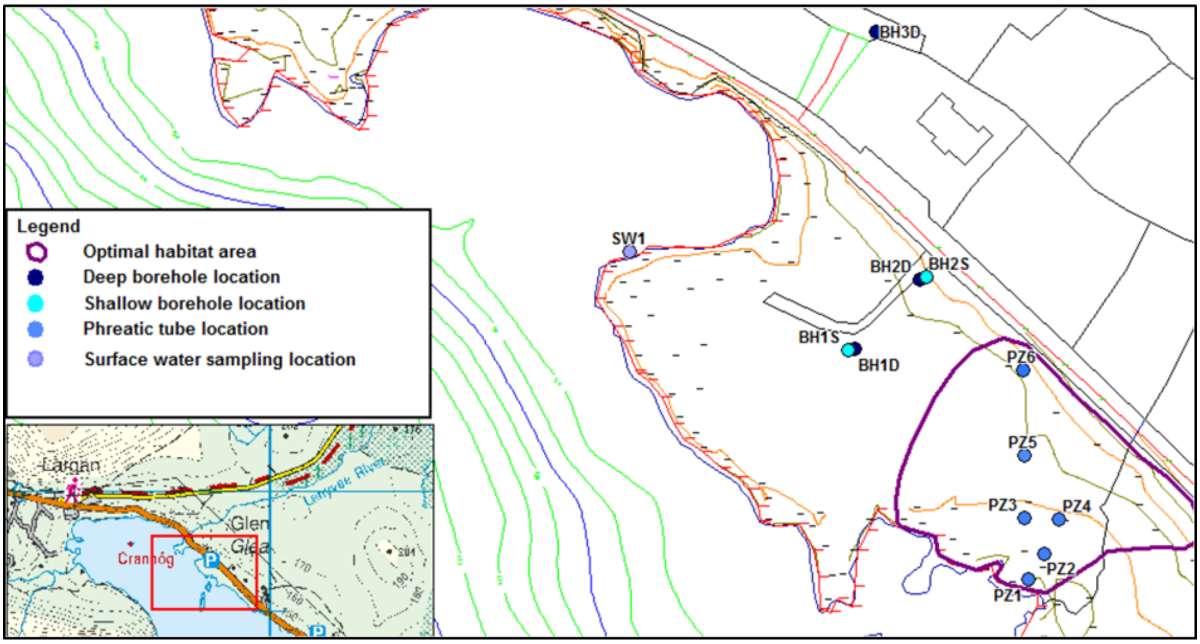


Figure 5-10: Borehole & Phreatic Tube Locations at Lough Talt Fen

Two options were considered as potential mitigation measures in order retain moisture (and in turn provide favourable habitat requirements for *V. geyeri*) within the fen habitat during extended dry periods, as follows:

- A surface irrigation system; and
- A deep artificial groundwater recharge system.

More intrusive measures to introduce water into these areas, requiring excavation and burial of materials was not considered appropriate due to the potential to impact the integrity of the fen habitat, its supporting terrestrial habitats and those adjoining areas of Lough Talt. Site investigations to provide further insight into optimal irrigation designs and placement will be confirmed upon receipt of planning consent.

The highly permeable nature of the main gravel sequence underlying the fen, combined with low lake levels during dry conditions means that it is unlikely to be possible to induce artesian conditions using deep (5-15m) artificial recharge. The surface irrigation system is likely to have a higher probability of success.

A surface irrigation system was previously adopted for a number of years at the Pollardstown Fen *Vertigo geyeri* habitat in Co. Kildare. A review of irrigation measures used at Pollardstown Fen and their scientific and transferability value was prepared by Dr. Evelyn Moorkens in 2018. The report is provided in full in **Volume 3 – Appendix B**. The results were generally mixed, however, the Pollardstown Fen studies provide useful insight beneficial for the Lough Talt mitigation measures being proposed, suggesting that surface irrigation generally yield most successful results in the wettest areas of the habitat, on sloping ground and that careful attention to the ponding of water is imperative in order to avoid excessive surface water ponding. These key learnings will greatly assist with the design and operation of the Lough Talt irrigation system

The equipment required for the system would include a pump for water abstraction, a power source for the pump, a pipe network for water distribution and a suitable mechanism (valves, holes, perforations or similar) to release water at appropriate discharge rates. ESB powerlines are situated along the adjacent road. A power supply will be required for the submersible pump. This will include connection to the existing overhead power supply and a small kiosk. A new ESB pole may be required but this would be located outside the SAC. The kiosk maybe located within the SAC along with cabling and ductwork. This work will be performed under derogation license from the NPWS and will not have an impact on the qualifying interests of the SAC.

Target discharge rates will be discharge rates which achieve the following:

- The ground surface of the fen remains wet at all times (maintaining the moist humid environment which represents optimal habitat),
- The discharged water does not collect/pond on the ground surface of the fen (which could result in submerging the optimal fen habitat).

If the surface irrigation system can be operated in such a manner, as it keeps the ground surface of the fen wet, while not leading to surface water ponding, then it will have been successful and will be the first step towards meeting the first mitigatory objective (Objective No.1) "*To maintain the optimal fen habitat conditions in the interim period of continued lake abstraction*".

5.5.3.1.2 Surface Irrigation System Set-up & Operation

This section provides details on each element of the proposed surface irrigation system which will be implemented as a mitigation measure focussed on maintaining optimal fen habitat conditions in the interim period of continued lake abstraction. On-going monitoring will be undertaken to determine the success of the system and adaptive measures will be implemented to refine and optimise the system as required. The system installation and initial monitoring will be completed in Year 1 with the focus being to achieve compliance with the mitigation measures within the short to medium term (3-5 years).

Irrigation Requirements

The area of the optimal habitat is shown in **Figure 5-10** and is approximately 4,000m^2; however, within this overall area a sub-area in the vicinity of PZ2, PZ3, PZ4 and PZ5 is where the calcareous groundwater seepages occur and this has been identified from an ecological perspective as the most favourable habitat for *V. geyeri*. This sub-area is where any impact will be realised, thus where mitigation measures are required and is the area where the proposed irrigation scheme will be focused.

Potential Evapotranspiration (PE) was used as a basis for estimating the volumes/rates of water which might be required to maintain moist conditions within the fen habitat during extended dry periods. A maximum monthly PE of 85mm (Oct 2014 to Oct 2017) is reported for the Claremorris Synoptic Meteorological station located approximately 45km south of Lough Talt. The daily average is therefore 2.74mm/day, increasing this by a factor of two is approximately 5.5mm/day, which is an indication of potential higher than average daily evaporation. This evaporation depth was applied to various percentages of the optimal habitat in order to provide estimations of potential daily water volumes required. Estimates of the daily water volume and average flow rates required, based on continuous irrigation throughout the day, for incrementally increasing area of the habitat, are provided in **Table 5.32**.

Table 5.32: Irrigation Volume and Flow Rate Requirement Estimates

Habitat Area	Irrigation Volume (m^3/day)	Flow Rate (l/min)	Habitat Area	Irrigation Volume (m^3)	Flow Rate (l/min)
5%	1.12	0.78	55%	12.37	8.59
10%	2.25	1.56	60%	13.50	9.37
15%	3.37	2.34	65%	14.62	10.15
20%	4.50	3.12	70%	15.75	10.93
25%	5.62	3.91	75%	16.87	11.72
30%	6.75	4.69	80%	18.00	12.50
35%	7.87	5.47	85%	19.12	13.28
40%	9.00	6.25	90%	20.25	14.06
45%	10.12	7.03	95%	21.37	14.84
50%	11.25	7.81	100%	22.49	15.62

Based on a site inspection completed 4th January 2018 it is estimated that 30% to 40% of the optimal habitat area will be irrigated (the area where groundwater seepages occur and where impact occurs), which equates to approximately 7 to 9 m^3/day or a continuous 4.7 to 6.3 litres/min of water being required for the surface irrigation system.

Irrigation supply

There are two primary water supply options:

- surface water from Lough Talt or
- groundwater from BH2D and/or BH3D[23].

[23] See **Figure 5.10** for borehole locations

The fen habitat is currently supported by artesian groundwater up-wellings and thus in order to try and best replicate the current natural system, with respect to water quality, it was concluded that sourcing groundwater from either or both BH2D and BH3D was the optimal option.

As borehole BH2D is on the same side of the road (west / south-west) as the fen habitat, it is proposed that the water supply be initially derived from this borehole. If additional water is required, then it would be sourced from BH3D. There are two road culverts located along the road section adjacent to the fen habitat, thus it would be straightforward to run a pipe from BH3D to the fen habitat (via one of these culverts) if required.

Both of these boreholes intercept highly permeable gravel sequences. Permeability testing was attempted on both these holes following installation but their permeability was too high to quantify (i.e. there was no water level response to the addition or removal of water). It is therefore anticipated that the proposed pumping from these boreholes (at the low pumping rates required) would not result in any additional water level drawdown at the fen itself but this would be monitored as part of the proposed mitigation. If any pumping induced water level drawdown was observed in the fen area from pumping at BH2D (which is located closest to the fen) then pumping would cease from this borehole and BH3D (which is located >50 from the fen habitat) would be pumped instead.

5.5.3.1.3 Surface Irrigation – System Design

The equipment required for the surface irrigation system would include a borehole pump for water abstraction, a power source for the pump, a pipe network for water distribution and leaking joints/valves suitable to release water at appropriate rates.

It is proposed that the surface irrigation system would comprise the following:

- **Submersible Pump:** A submersible pump would be installed in BH2D and/or BH3D (See **Figure 5-10**). There are a number of pump options but two relatively straight forward options for pumping, both of which are appropriate for 50mm diameter casing and 15m deep boreholes are:
  - Grundfos MP1 (capable of pumping rates of 7 to 38 litres/min at 10m head).
    - The MP1 is capable of supplying a large range of flows, including more than twice our estimated requirement for the entire habitat area.
    - The MP1 can supply flow at a large range of heads, which give more flexibility with sizing the pipe of the irrigation network.
  - WaSP P5 (capable of pumping rates of 1 to 10 litres/min at 10m head).
    - The WaSP is capable of pumping a maximum of 10 litres/min at 10m head, which exceeds the 4.7 to 6.3 litres/min estimated requirement.
    - There will be system head in addition to the elevation head, which will be dependent on the system head losses and flow rate.
    - The WaSP is not capable of providing the irrigation flow rate for greater than 60% of habitat area at 10m total head.
- **Power Supply**: A power supply will be required for the submersible pump. This will include connection to the existing overhead power supply and a small kiosk. A new ESB pole may be required but this would be located outside the SAC. The kiosk maybe located within the SAC along with cabling and ductwork. This work will be performed under derogation license from the NPWS and will not have an impact on the qualifying interests of the SAC.
- **Pump Headworks**: Comprising a stop valve, butterfly valve, pressure gauge, and flow meter.

- **Pipe Network & Discharge Mechanism:** A distribution pipe comprising:
  - A butterfly valve(s) to isolation the pipeline, as required.
  - 25mm diameter pipe, with 5mm diameter holes (perforations), every 1m distance to allow even distribution of the irrigation system across the target area of habitat. The holes are specially designed to spiral water at pressure through the opening thus minimising blockages.
  - The pipe will be laid as follows:
    - At ground surface, in elevated areas close to the particular habitat to be irrigated.
  - Where possible, the pipe will be laid at approximately the same elevation, or slightly declining elevation away from the pump, in order to help balance pressures and head losses.

The exact make-up of the surface irrigation system will be confirmed at the start of the process while on-site but a notional design for the surface irrigations system is illustrated in **Figure 5-11**. All site works will be undertaken under the supervision of an ecologist.

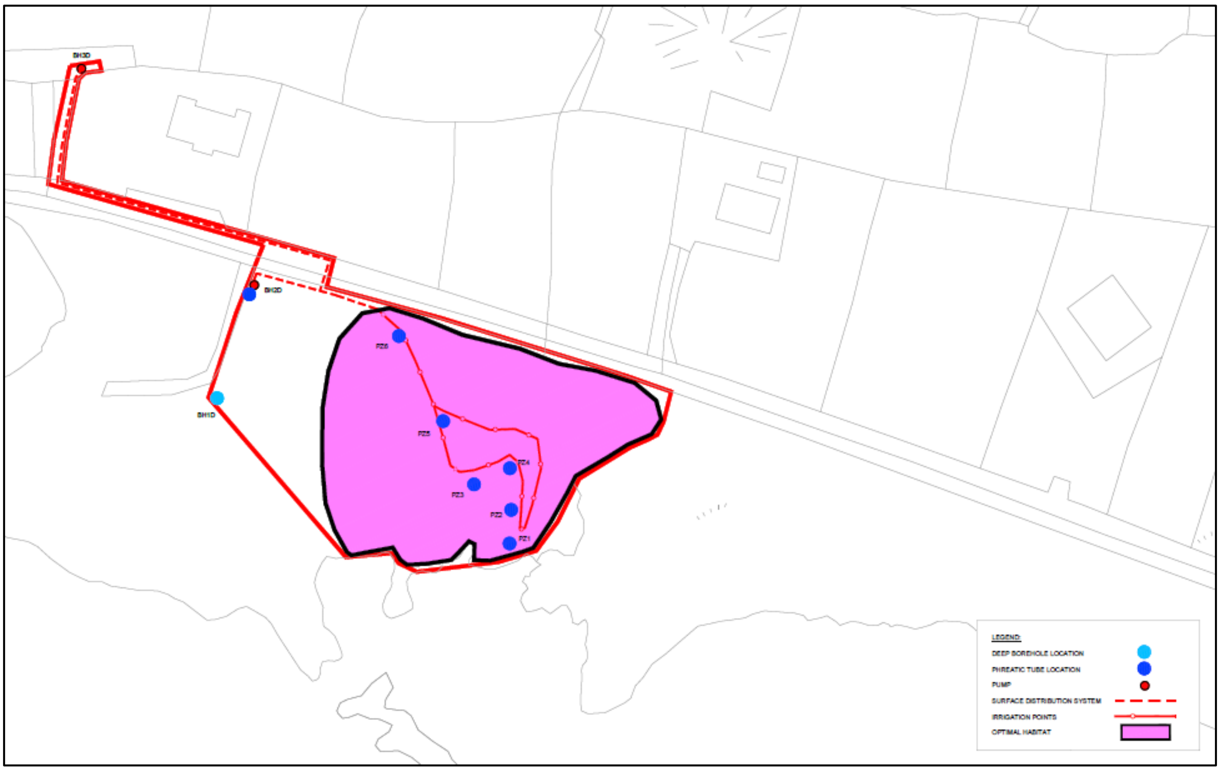


Figure 5-11: Notional Surface Irrigation System Layout

5.5.3.1.4 Surface Irrigation – System Operation

The surface irrigation system would operate as follows:

- During wet periods, the irrigation distribution system will be filled with water sourced from the borehole, with the end of hose valves and all jointing/sampling taps fully closed.
- Once filled, the valves at the pump headworks will be closed to retain the full water volume within the distribution network.

  - The distribution network will be filled in advance of dry periods, thus the initial volume required to fill the distribution system is sourced during wet (high groundwater periods), reducing pumping requirements from the borehole during dry periods.
- Irrigation of the targeted habitat area will commence in advance of predicted dry periods.
- Pumping will commence from the borehole(s) and simultaneously the valves will be opened between the pump headworks and the distribution hoses:
  - One operator will be required to monitor the flow meter on the headworks in order to achieve the target total irrigation flow rate (which will depend on area to be irrigated, likely to be in the 4-6 litres/minute range).
  - A second operator will evaluate the habitat site, and partially open the localised jointing/sampling taps in order to irrigate areas deemed to require wetting. The second operator will adjust the joints/sample taps so that they discharge at appropriate rates (i.e. wetting the areas but not inundating the areas).
  - The two operators will communicate during the early stages of initiation of pumping in order to achieve the correct balance between the pumping rate and the discharge rate, again with the focus on maintaining moisture in the habitat, while avoiding inundation and minimising pumping.
- The habitat will require on-going monitoring during the irrigation periods in order to maintain favourable habitat conditions and to make any necessary adjustments to the irrigation system (e.g. adjusting borehole pumping rate, adjust pipe positions, adjust joints/taps, etc.).
- The system will be operated and monitored initially in order to optimise the operation of the system and to identify any system issues or limits which may need resolution.
- Through monitoring, adaptive measures will be employed to refine and optimise the irrigation system if required to maintain favourable habitat conditions for snails (including Vertigo geyeri) during dry periods.

5.5.3.1.5 Site Monitoring

The second objective of the mitigation measures (Objective No.2) is to monitor the fen habitat conditions during the period of continued lake abstraction. Intensive monitoring of the fen habitat will be undertaken during the surface irrigation mitigation. Subsequently, less intensive on-going monitoring of the fen habitat will be required for the long term implementation of the surface irrigation scheme. Groundwater level, groundwater quality, lake level, fen moisture and site specific rainfall data will all be evaluated in tandem in order to evaluate the irrigation system performance while also considering the impacts of seasonal variation and precipitation. It is proposed that groundwater from BH2D and/or BH3D will be used as a water supply for the irrigation system.

The initial monitoring period of the irrigation system and fen habitat will include the following:

- Groundwater levels:
  - Manual groundwater level measurements in all boreholes and phreatic tubes.
  - Download of groundwater level loggers to provide detailed water level fluctuation insight.
- Water quality:

    - Measurement of field water quality (pH, conductivity and temperature) of water ponding at the surface of the fen habitat and the water pumped from the borehole(s).
- Rainfall - installation of tipping bucket rain gauge and logger to measure site specific rainfall.
- Lake levels measurements.
- Photographic record and site observations of water levels within fen area.
- Quantitative measurements of moisture at fen surface (litter level) using pellets (or similar).

An appropriate long term monitoring regime will be developed for the scheme on completion of the first year of monitoring.

5.5.3.1.6 Habitat Risks & Risk Management measures

An assessment of the potential risks to the fen habitat and the measures proposed to manage these risks are provided in **Table 5.33**.

Table 5.33: Potential Risks & Risk Management Measures associated with Surface Irrigation Scheme

Potential Risk	Actions Proposed to Manage Risk
Habitat disturbance - during irrigation system installation	Minimise the number of people entering the habitat area. Minimise the number of trips into the habitat area. Access the habitat area from high ground, stay on dry ground or high ground (rocks, heather, hummocks, etc.) wherever possible. Use light weight equipment wherever possible. Only carry minimal required equipment to assemble the irrigation system to minimise loading on the habitat during access. Install the irrigation system on dry and high ground wherever possible in order to keep equipment out of the most sensitive habitat area, and also when the system needs to be manipulated access to more sensitive habitat is not required.
Habitat disturbance - during monitoring and operation	Minimise the number of people entering the habitat area. Minimise the number of trips into the habitat area. Access the habitat area from high ground, stay on dry ground or high ground (rocks, heather, hummocks, etc.) wherever possible. Use light weight equipment wherever possible. Only carry minimal required equipment to minimise loading on the habitat during access. Use automated equipment (e.g. data loggers) wherever possible in order to minimise the number of trips into the habitat area.
Habitat contamination - during irrigation system installation, operation and monitoring	Ensure that all equipment brought into the habitat is clean and does not introduce contaminants (e.g. oil, grease or other hydrocarbons) into the fen area. Personnel entering the habitat should not have applied any sun screen or insect repellents.
Flooding/inundation of habitat – due to excess flow discharge from surface irrigation system	Start with only small discharges to the fen habitat and increase slowly as required. Constant visual inspection at the start of irrigation to ensure water

Potential Risk	Actions Proposed to Manage Risk
	levels not rising significantly in habitat area. Regular monitoring of weather forecast with regards to predicted rainfall.
Drying out of habitat – due to insufficient discharge from the surface irrigation system	Constant visual inspection at the start of irrigation to ensure moisture being maintained or increased appropriately. Regular monitoring of weather forecast with regards to predicted rainfall (or lack thereof). Use of pellets to measure moisture content and ensure that moisture targets are being achieved.
Drying out of habitat – due to cessation of pumping due to theft of equipment	Secure equipment in kiosk with lockable devices where possible (including locked borehole covers with slots for pipework). Prevent un-approved vehicular access (if possible). Discrete positioning of equipment.
Drying out of habitat – due to cessation of pumping due to power failure	Regular maintenance schedule for equipment. Connection to the local ESB supply to be secured.

5.5.3.1.7 Surface Irrigation Scheme Implementation

On approval of the planning application, a mitigation measures implementation plan document will be developed for the works, including details of the initial monitoring period and the subsequent commission. This plan will encompass and provide additional detail on all aspects presented above and will include the following key areas:

Mitigation Objectives

- Irrigation Scheme:
  - Set-up
  - Monitoring
- Irrigation Scheme - Objectives/Deliverables:
  - including key outcomes/metrics, water level responses, fen moisture targets, discharge rate targets, etc.
- Irrigation Scheme – Commissioning:
  - Set-up
  - Monitoring
- Timeframe
- Contingencies - should the irrigation approach prove unsuccessful

The mitigation measures implementation plan will be provided to the NPWS and all relevant stakeholders for approval prior to initiation.

It is anticipated that the installation of the irrigation system will be undertaken during the May to September period in order to capture the traditionally driest part of the year. The set-up and early monitoring of the system is likely to be labour intensive, requiring two people at the set-up stage and regular on-site attendance throughout the monitoring period.

It is envisaged that the irrigation system installation will include the following:

- Set-up: up to one week;
- Start monitoring: Week 1 will require intensive monitoring and system adjustment (two people on site for initial week); and
- On-going monitoring: Notional extended 3-4 month monitoring with on-site attendance dependent on system operation and monitoring results.

5.5.3.1.8 Likelihood of Success of Mitigation Measures for *Vertigo geyeri*

The likelihood of achieving the objectives using irrigation at Lough Talt are therefore summarised as follows:

- Objective 1 - to ensure that sufficient water is delivered to key habitat areas to prevent the surface layer from drying out and forming a crust that is less permeable than the sub-soil.

The likelihood of achieving this objective is high as the key seepage areas at Lough Talt are discrete and few, and can be focused on with the benefit of the wealth of data from the Pollardstown project, see **Volume 3, Appendix B**. The benefit of the experience of the irrigation process, and of linking triggers to the water level data is extremely helpful in this regard.

- Objective 2 - to ensure that the habitat conditions are suitable habitat for *Vertigo geyeri* throughout the year and thus support the reintroduction of the snail.

The likelihood of achieving this objective is high as the microhabitat conditions required for *Vertigo geyeri* has been detailed from the Pollardstown project, and particularly in the thesis of Anna Kuczyńska (2008) and the publication of Kuczyńska & Moorkens (2010).

The knowledge gained from the Pollardstown project provides a high level of confidence in the choice of translocation microhabitats, see **Volume 3 Appendix B**.

The unknown element in the likelihood of achieving a sustainable population of *Vertigo geyeri* following translocation lies in the final structure and spread of optimal and sub-optimal habitat to allow the species to spread and to move the small distances needed as a reaction to temporary weather extremes. The unknowns include possible changes to local weather patterns since 2007, possible changes in catchment management that may have an effect at the fen, and permanent changes that may have occurred in the microhabitat affecting seepage direction and emergence that may have occurred before the potential impact from the abstraction was identified. These are all elements that are beyond the control of the proposed project and leave a residual uncertainty in the project. However, the proposed measures provide the best possible means of achieving a continuity of the function of the appropriate habitat areas and the achievement of a successful translocation of *Vertigo geyeri* and an ongoing living population at the Lough Hoe Bog cSAC.

A review report of irrigation measures used at Pollardstown Fen and their scientific and transferability value is provided in full in **Volume 3 Appendix B**.

5.5.3.1.9 Conclusion of Hydrological Mitigation Measures for *Vertigo geyeri*

The hydrological and hydrogeological mitigation measures described in **Section 5.5.3.1** will mitigate for potential adverse effects to the fen habitat which provides suitability for *V. geyeri*. This mitigation will implement a combination of irrigation and monitoring to provide suitable habitat for *V. geyeri* to establish. However, it should be noted that irrigation measures will not influence the reintroduction or recolonisation and establishment of *V. geyeri* within this area of Lough Talt. The reintroduction of the species is considered in **Volume 3 Compensation Measures**.

5.5.3.2 Mitigation Measures for White-clawed Crayfish on River Moy SAC

The invert bed level of the Eighnagh River channel at the outlet of Lough Talt is 135.5maod[24] which has been calculated using available Lough Talt topographical survey information. Under the existing abstraction rates of 8 MLD, during dry periods, the lake level drops below 135.5maod and the Eighnagh River dries out between the outflow from the lake to the river to its confluence with the Lough Hoe River 300m downstream. There are indications that there is no flow from Lough Talt to the Eighnagh River for 39 days of an average year.

White-clawed crayfish may be affected during these periods through barriers to migration, loss of refugia and foraging grounds. Low water levels caused by natural droughts or over-abstraction can be devastating to local crayfish populations, increasing their vulnerability to predation. This may have a significant impact on local crayfish populations through the reduction in the availability of suitable habitat within the river during drought occurrences while also impacting on the connectivity between Lough Talt and the Eighnagh River. Given that it is also unknown what level of significance this occurrence may be having on the overall population dynamics of the white-clawed crayfish within the River Moy SAC, it has been determined, using the precautionary principle, to provide mitigation measures for the translocation of the species during drought conditions, given that reducing the abstraction volumes from Lough Talt is not a viable option. The location along the Eighnagh River for these translocation efforts are presented in **Figure 5-12**.

A baseline survey of the 300m stretch of river between the lake outlet and the main channel of the Eighnagh River will be undertaken in advance of proposed translocation activities, and under normal flow conditions. These surveys should be undertaken during optimal survey timeframes if possible i.e. July to September, or if needs be, during suboptimal periods (December to June) to avoid dry conditions in the channel. The months of October and November should be avoided as this is the mating period.

5.5.3.2.1 Telemetry and Trigger Levels for Monitoring

RPS has developed a lake water balance model to assess abstraction management. For example a reduced abstraction rate of 4,000m^3/d (approximately half the normal abstraction rate) was modelled and there were virtually no instances where a lake level dropped below 135.73maod. Therefore, the trigger level to commence monitoring to assess the water levels in the river is set at 135.7maod.

[24] Metres above Ordnance Datum

At present the rainfall, level and outflow of Lough Talt is monitored separately by number of pieces of equipment. Once planning permission has been granted, it is proposed to combine these different monitoring streams into one telemetry data logger with a solar power supply that will upload data to a web-based interface on a daily basis which will be monitored by the aquatic ecologist and project manager.

In the event that lake trigger is met, a suitably qualified and experienced aquatic ecologist will be deployed to site to undertake monitoring of the river under licence from the NPWS. Weather forecasts will be monitored to inform the likely duration of the drought and mitigation measures to be applied.

5.5.3.2.2 Methodology for the Capture and Release of White-clawed Crayfish

White-clawed Crayfish can be found in shallow riffles and in streams less than 0.5 m wide with just a few centimetres of water (Rogers & Holdich, 1995). Crayfish need high habitat heterogeneity[25]. Larger crayfish must have stones to hide under, or an earthen bank in which to burrow. Hatchlings shelter in vegetation, gravel and among fine tree-roots. Smaller crayfish are typically found among weed and debris in shallow water. Larger juveniles in particular may also be found among cobbles and detritus such as leaf litter.

Where water levels in the river are deemed to be unsuitable to support crayfish, a crayfish salvage and translocation operation will be initiated within the affected reach in order to avoid stranding.

Search Method

Each search of the channel will begin at the confluence of the channel and the downstream river and progress upstream to the natural weir at the lake. White-clawed crayfish may burrow into the channel bed as the channel dries and emerge sometime after flow has ceased. Translocation operations will therefore continue for several days after flow from the lake has ceased.

On each day of the translocation activities, ecologists will walk the length of the channel carefully hand-searching stretches of river bed and looking for refuges for crayfish (stones, crevices, burrows etc.). When captured, crayfish will be placed into suitable containers and transported to either the lake or downstream river for release. The preference for the translocation site will be confirmed with NPWS in advance of translocation activities. Crayfish will be measured using a Vernier callipers (carapace length; size distribution ratios: juvenile to adult ratio) and sexed (male female ratio) to provide additional information on the SAC population to the NPWS. Sex of hatchlings will be indeterminate in the field. Locations and numbers of crayfish captured and released will be recorded so as to provide data on the effectiveness of the mitigation and adapt measures as required.

Areas where crayfish may have taken refuge during the decreasing flow in the channel are of particular importance, these include areas where the bed material is soft and would allow crayfish to burrow, the remaining pools, areas under boulders that provided crevices for crayfish to hide and areas under vegetation roots or over hangs that provide refuges for crayfish.

[25] https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000633.pdf

Survey effort

Translocation activities will continue until there is reasonable certainty that no live crayfish that can be captured through hand-searching remain within the channel. To achieve this, operations will progress in a similar vain to electro fishing depletion methods. The channel will be searched until no live crayfish are captured on two consecutive days.

On the first day of the translocations, searches of the channel will be carried continually throughout the day.

On the second day and all following days until the end of the translocation activities, searches of the channel will continue until no crayfish are captured on two consecutive search days. At which point searches will stop.

With this method the minimum number of days that searches will be carried out is two. If no crayfish are captured on the first day, searches will be carried out continually throughout the day and on a second day.

Survey Personnel and Licencing

Anyone intending to work on this species, either to catch or disturb the species is required to obtain a license from NPWS under Sections 22, 23 and 34 of the Wildlife Acts. A suitably qualified ecologist, experienced in the translocation of the species, will be employed to undertake the proposed translocations, and will obtain a license from NPWS in advance of translocations, together with undertaking consultations and reporting back to NPWS (and Inland Fisheries Ireland) as required.

Biosecurity

To prevent the spread of crayfish plague, or the introduction of non-native invasive freshwater plants and animals, the Check-Clean-Dry protocol promoted by Invasive Species Ireland, Inland Fisheries Ireland[26] and the National Biodiversity Data Centre, will be employed as follows:

- Check equipment and clothing for living organisms;
- Pay particular attention to areas that are damp or hard to inspect;
- Clean and wash all equipment, footwear and clothes thoroughly;
- If you do come across any organisms, leave them at the water body where you found them;
- Dry all equipment and clothing – some species can live for many days in moist conditions; and
- Make sure you don’t transfer water elsewhere.

The ecologists undertaking the translocation work must carry a disinfection box, containing Virkon Aquatic or another proprietary disinfectant, a spray bottle, clothes or sponges, a scrubbing brush and protective gloves. A basin or bucket of sufficient size to allow footwear to be scrubbed with disinfectant solution is also useful. All sampling equipment (trays, buckets, nets etc.) must be cleaned, rinsed or wiped down after dipping in the disinfectant. Disinfectants must be used with care

[26] https://www.fisheriesireland.ie/Biosecurity/biosecurity-protocol-for-field-survey-work.html

and in strict accordance with the manufacturer's instructions. They must be disposed of safely and never in close proximity to open waters.

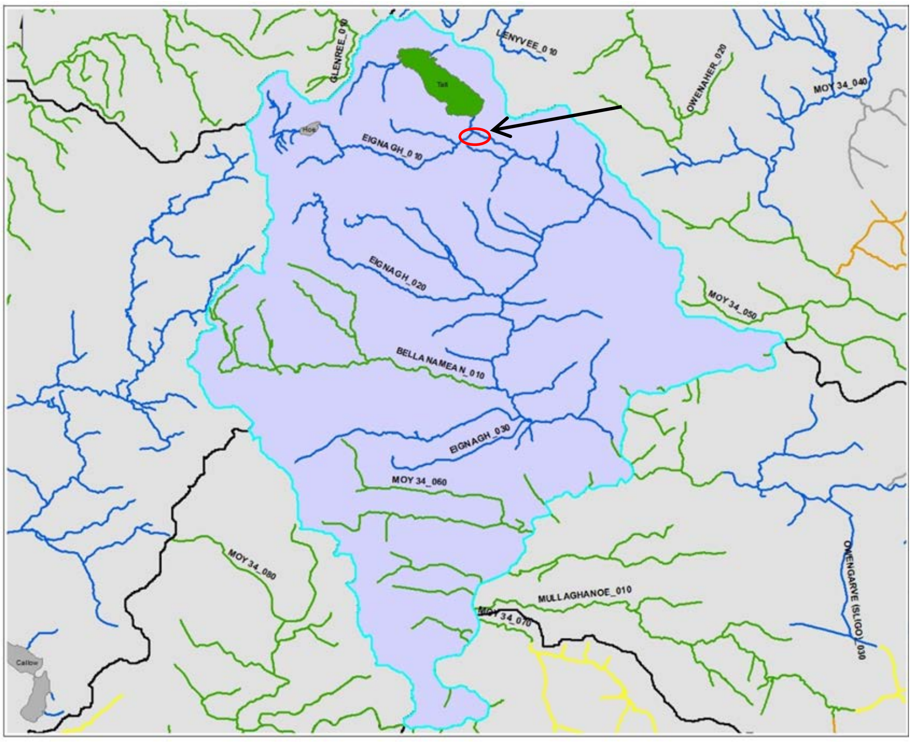


Figure 5-12: Lough Talt subcatchment and location where translocation activities are proposed

5.5.4 Programme of Implantation of Mitigation Measures

Once planning consent has been obtained for the WTP upgrade, the implementation of the mitigation measures will commence.

The programme and process for the implementation of the mitigation measures is outlined below.

Year 1

- Implementation of CEMP on construction of WTP;
- Monitoring and translocation of White-clawed Crayfish if trigger level is met;
- Monitoring of irrigation system function; and
- Monitoring of water levels.

Year 2

- Monitoring of compliance with CEMP for duration of construction period;
- Monitoring of molluscs species;
- Monitoring of micro-habitat conditions;
- Monitoring of irrigation system function; and
- Monitoring of water levels.

Year 3

- Monitoring of molluscs species;
- Monitoring of micro-habitat conditions;
- Monitoring of irrigation system function; and
- Monitoring of water levels.

Year 4 to Year 10

From Year 4 it is expected that a reduced monitoring regime may suffice for the duration of the operation of the WTP upgrade. However, it will include the following:

- Monitoring of the irrigation programme.

5.6 INTEGRITY OF THE EUROPEAN SITE ASSESSMENT

From the *Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (EC, 2002), the meaning of integrity is described as follows;

> ‘*The integrity of a site involves its ecological functions. The decision as to whether it is adversely affected should focus on and be limited to the site’s conservation objectives’ (MN2000, paragraph 4.6(3))*’.

5.6.1 Integrity of Lough Hoe SAC

The site specific conservation objectives for the Lough Hoe SAC were published on August 31st 2017 and are available on the NPWS website at the following link: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000633.pdf.

The overarching conservation objective for Lough Hoe Bog SAC is to maintain or restore the favourable conservation condition of the habitats and species for which this site is designated. The conservation condition of Lough Hoe Bog SAC is defined by the attributes and targets for each feature of qualifying interest described in the conservation objectives supporting document.

From the information gathered and the predictions made about the changes that are likely to result from the construction, operation and decommissioning stages of the project, the integrity of site checklist is completed for Lough Hoe Bog SAC in **Table 5.34** below.

Table 5.34: Integrity of Site Checklist for Lough Hoe SAC

Conservation Objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
Cause delays in progress towards achieving the conservation objectives of the site?	Yes	There will be no impacts to the QIs of Lough Hoe Bog SAC during the construction stage. Abstraction during the operation stage of the Lough Talt RWSS WTP upgrade will cause delays in achieving the conservation objectives of *V*.

Conservation Objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
		geyeri, a species of qualifying interest for Lough Hoe Bog SAC. Following the cessation of the raw water abstraction when the WTP is decommissioned and the replacement source is in place, the hydrological regime of the fen habitat will return to a more natural state.
Interrupt progress towards achieving the conservation objectives of the site?	Yes	There will be no impacts to the QIs of Lough Hoe Bog SAC during the construction stage. Abstraction during the operation of the Lough Talt RWSS WTP upgrade will interrupt progress in achieving the conservation objectives of *V. geyeri*, a species of qualifying interest for Lough Hoe Bog SAC. Following the cessation of the raw water abstraction when the WTP is decommissioned and the replacement source is in place, the hydrological regime of the fen habitat will return to a more natural state.
Disrupt those factors that help to maintain the favourable conditions of the site?	Yes	There will be no impacts to the QIs of Lough Hoe Bog SAC during the construction stage. The water abstraction for the operation of the WTP upgrade can result in lake level drawdown and subsequent impacts to the hydrological and hydrogeological regime of habitats supporting *V. geyeri*. Therefore, the proposed scheme has the potential to affect the structure and function and favourable conservation conditions of the site. Following the cessation of the raw water abstraction when the WTP is decommissioned and the replacement source is in place, the hydrological regime of the fen habitat will return to a more natural state.
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	Yes	There will be no impacts to the QIs of Lough Hoe Bog SAC during the construction stage. There has been a significant decline in indicator mollusc species in the fen habitats around the lake since 1997 including V. *geyeri* which has not been recorded at the site since 2007. This decline is outlined in the Assessment of *V. geyeri* habitat at Lough Talt (See **Table 3.2**, **Appendix C**). Following the cessation of the raw water abstraction when the WTP is decommissioned and the replacement source is in place, the hydrological regime of the fen habitat will return to a more natural state.
Other Indicators		
Does the project or plan have the potential to:		
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	No	There will be no impacts to the QIs of Lough Hoe Bog SAC during the construction stage.
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	No	The proposed project will continue to change the abiotic and biotic dynamics that define the structure and function, of *V. geyeri* population along the north-eastern shores of Lough Talt within Lough Hoe SAC. Impacts to the fen habitat supporting suitable conditions for *V. geyeri* will be mitigated through a system of irrigation and rewetting

Conservation Objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
		this habitat.
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	No	There will be no impacts to the QIs of Lough Hoe Bog SAC during the construction stage. The continued abstraction from Lough Talt at current levels will interfere with predicted or expected natural changes, such as surface and groundwater regimes at Lough Hoe SAC. However these impacts will be mitigated through a system of irrigation and rewetting of the calcareous fen habitat at risk of groundwater drawdown from the continuing abstraction process.
Reduce the area of key habitats?	No	There will be no permanent loss of key habitats within Lough Hoe SAC during the construction stage. To achieve the conservation objectives of functional habitat size (in particular the calcareous fen habitat on the north-eastern shores of Lough Talt which provides suitability for *V. geyeri*) at designation, it must be maintained at continuously favourable conditions. The continued abstraction from Lough Talt at current levels risks affecting hydrological and hydrogeological interactions of the rich calcareous fen habitat adjoining Lough Talt which previously supported *V. geyeri* and currently provides suitable habitat structure to support this species. However, these impacts will be mitigated through a system of irrigation and rewetting of this habitat to provide suitable conditions for *V. geyeri*.
Reduce the population of key species?	Yes	It is considered that there will be no direct impacts to the qualifying species of Lough Hoe SAC during the construction stage of the project. *V. geyeri* has not been recorded at the site since 2007. The proposed mitigation measures will improve the habitat conditions during drought events through a system of irrigation and rewetting of this habitat to provide suitable conditions for *V. geyeri*, however the mitigation measures do not mitigate for historical loss of the species due to abstraction pressures.
Change the balance between key species?	Yes	The hydrological and hydrogeological balance for *V. geyeri*, a species of qualifying interest at Lough Hoe Bog will continue to be impacted as a result of the proposed water abstraction associated with the Lough Talt RWSS WTP upgrade development. However, these impacts will be mitigated through a system of irrigation and rewetting of this habitat to provide suitable conditions for *V. geyeri*. The proposed mitigation measures will improve the habitat conditions during drought events through a system of irrigation and rewetting of this habitat to provide suitable conditions for *V. geyeri*, however the mitigation measures do not mitigate for historical loss of the species due to abstraction pressures.
Reduce diversity of the site?	Yes	The diversity of the macroinvertebrate community recorded in Lough Talt during the current survey signifies good water quality. There has been a significant decline in indicator mollusc species in the fen habitats around the

Conservation Objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
		lake since 1997 including V. *geyeri* which has not been recorded at the site since 2007. The proposed mitigation measures will improve the habitat conditions during drought events through a system of irrigation and rewetting of this habitat to provide suitable conditions for *V. geyeri*, however the mitigation measures do not mitigate for historical loss of the species due to abstraction pressures.
Result in disturbance that could affect population size or density or the balance between key species?	No	The sustained abstraction of water from Lough Talt at current levels of operation will continue to affect suitable hydrological and hydrogeological requirements for *V. geyeri* populations at Lough Talt. However, these impacts will be mitigated through a system of irrigation and rewetting of this habitat to provide suitable conditions for *V. geyeri*.
Result in fragmentation?	No	The sustained abstraction of water from Lough Talt at current levels of operation will continue to affect suitable hydrological and hydrogeological requirements for *V. geyeri* populations at Lough Talt, thereby restricting their population size and distribution at Lough Hoe Bog SAC. However these potential impacts will be mitigated through a system of irrigation and rewetting of this habitat to provide suitable conditions for *V. geyeri*.
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding, etc.)?	No	Sustained pressures on the hydrological and hydrological regime will have a significant effect on the structure and function of Lough Hoe Bog SAC. However these potential impacts will be mitigated through a system of irrigation of the calcareous fen habitat on the north-eastern shore of Lough Talt to counteract potential effects associated with the proposed abstraction (such as groundwater drawdown) and to provide suitable conditions for *V.* geyeri.

The hydrological and hydrogeological mitigation measures described in **Section 5.5.3.1** will mitigate for the reduction and fragmentation of habitat available for the *Vertigo geyeri* potential within the fen habitat at the north-eastern end of Lough Talt. The mitigation will implement a combination of irrigation and monitoring of this fen habitat to provide suitable habitat for *V. geyeri* populations to exist and subsequently thrive. However, the mitigation measures do not mitigate for historical loss due to abstraction pressures and therefore the conservation objectives of the site cannot be achieved. Therefore, the Lough Talt RWSS WTP upgrade will adversely affect the integrity of Lough Hoe Bog SAC in view of the conservation objectives for the site.

5.6.2 Integrity of River Moy SAC

The site specific conservation objectives for the River Moy SAC are available on the NPWS website https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002298.pdf and were published on the 03rd August 2016. The overarching conservation objective for this

European site is to maintain of restore favourable conservation status / condition for its component features of Qualifying Interest; i.e. the habitats and species for which this site is designated.

Potential exists for impacts during the construction, operation and decommissioning phases of the Lough Talt RWSS WTP upgrade; however these can be readily mitigated through the implementation of mitigation as outlined in **Section 5.5**.

From the information gathered and the predictions made about the changes that are likely to result from the construction operation and decommissioning stages of the project, the integrity of site checklist is completed for Lough Hoe Bog and River Moy SACs in **Table 5.35** below.

Table 5.35: Integrity of Site Checklist for River Moy SAC

<table>
<tr><th colspan="3">Conservation Objectives</th></tr>
<tr><th>Does the project have the potential to:</th><th>Yes or No</th><th>Comment</th></tr>
<tr><td>Cause delays in progress towards achieving the conservation objectives of the site?</td><td>No</td><td rowspan="4">There will be no impacts to the QIs of the River Moy SAC during the construction stage due to project design and the best practice and mitigation measures implemented throughout. The operation of the WTP upgrade results in the dewatering of a 300m stretch of the Eighnagh River, downstream of its outlet from Lough Talt, for 39 days on the average year. A diminished or absent water supply within the Eighnagh River will potentially cause delays, interrupt progress and disrupt those factors that may achieve or maintain the favourable conservation conditions for in-situ or localised White clawed crayfish populations, a QI species for this European site. In addition, dry flow periods within the Eighnagh River may interfere with the balance, distribution and density of this QI species.

However, mitigation measures which include for monitoring and where required, capture and translocation of White-clawed crayfish are proposed to counteract these potential impacts. These are described in detail in 5.5.3.2.

The cessation of water abstraction during the decommissioning stage will affect surface water regime of the river outflow and will consequently result in a positive effect on the water dependent species of the River Moy SAC as naturally occurring drought conditions will not be exacerbated by the abstraction of 8MLD, and it is unlikely that the Eighnagh River will dry out annually thereby providing more habitat for aquatic species such as White-clawed Crayfish during drought conditions.</td></tr>
<tr><td>Interrupt progress towards achieving the conservation objectives of the site?</td><td>No</td></tr>
<tr><td>Disrupt those factors that help to maintain the favourable conditions of the site?</td><td>No</td></tr>
<tr><td>Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?</td><td>No</td></tr>
<tr><th colspan="3">Other Indicators</th></tr>
<tr><th>Does the project or plan have the potential to:</th><th></th><th></th></tr>
<tr><td>Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?</td><td>No</td><td>There will be no impacts to the QIs of the River Moy SAC during the construction stage. The water quality in the Eighnagh River has consistently been rated Q5/Q4-5 (high status). The operation of the WTP causes the drying out of 300m of the Eighnagh River, downstream of its outlet from Lough Talt. A diminished or absent water supply will present changes to the vital defining aspects the Eighnagh River</td></tr>
</table>

Conservation Objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
		along this stretch, in particular the change or absence of suitable habitat for White-clawed crayfish, a species of Qualifying Interest for the River Moy SAC. However, mitigation measures which include for monitoring and where required, capture and translocation of White-clawed crayfish are proposed to counteract these potential impacts. These are described in detail in **Section 5.5.3.2.**
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	No	There will be no impacts to the QIs of the River Moy SAC during the construction stage. The absence of flows in 300m of the Eighnagh River for an average of 39 days may change the local dynamics of in-situ white-clawed crayfish populations. A diminished water supply potentially increases the rates of stranding leading to subsequent mortality and predation of the local population. However, mitigation measures which include for monitoring and where required, capture and translocation of White-clawed crayfish are proposed to counteract these potential impacts. These are described in detail in **Section 5.5.3.2**. The cessation of water abstraction during the decommissioning stage will affect surface water regime of the river outflow and will consequently result in a positive effect on the water dependent species of the River Moy SAC as naturally occurring drought conditions will not be exacerbated by the abstraction of 8MLD, and it is unlikely that the Eighnagh River will dry out annually thereby providing more habitat for aquatic species such as White-clawed Crayfish during drought conditions.
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	No	There will be no impacts to the QIs of River Moy SAC during the construction stage. The Eighnagh River is the outflowing river from Lough Talt and is a tributary of the River Moy. Lough Talt catchment amounts to approximately 1.87% of the total Moy catchment and the Lough Talt catchment accounts for approximately 0.73% of the median (50%) flow of the River. Based on the size of the Moy catchment the drying out of the Eighnagh River for 39 days is unlikely to cause a significant change to the hydrological regime of the Moy catchment downstream. No significant change to the hydrological regime of this habitat is expected. The cessation of water abstraction during the decommissioning stage will affect surface water regime of the river outflow and will consequently result in a positive effect on the water dependent species of the River Moy SAC as naturally occurring drought conditions will not be exacerbated by the abstraction of 8MLD, and it is unlikely that the Eighnagh River will dry out annually thereby providing more habitat for aquatic species such as White-clawed Crayfish during drought conditions.
Reduce the area of key habitats?	No	There will be no permanent loss of key habitats within River Moy SAC during the construction stage. To achieve the conservation objectives of functional habitat size at designation, it must be maintained at continuously

Conservation Objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
		favourable conditions. The absence of water flow in 300m of the Eighnagh River for an average of 39 days will reduce the area of suitable habitat for the in-situ white-clawed crayfish populations. The seasonal and temporary drying out of the Eighnagh River will result in reduction of suitable habitat for White-clawed crayfish. However, mitigation measures which include for monitoring and where required, capture and translocation of White-clawed crayfish are proposed to counteract these potential impacts. These are described in detail in **Section 5.5.3.2**. The cessation of water abstraction during the decommissioning stage will affect surface water regime of the river outflow and will consequently result in a positive effect on the water dependent species of the River Moy SAC as naturally occurring drought conditions will not be exacerbated by the abstraction of 8MLD, and it is unlikely that the Eighnagh River will dry out annually thereby providing more habitat for aquatic species such as White-clawed Crayfish during drought conditions.
Reduce the population of key species?	No	It is considered that there will be no direct impacts to the qualifying species of River Moy SAC during the construction stage of the project. There is a potential reduction in key species such as White-clawed crayfish during the operation of the WTP upgrade through the potential absence of water flow in 300m of the Eighnagh River for an average of 39 days. However, mitigation measures which include for monitoring and where required, capture and translocation of White-clawed crayfish are proposed to counteract these potential impacts. These are described in detail in **Section 5.5.3.2**.
Change the balance between key species?	No	The hydrological balance of the habitat supporting for White-clawed crayfish, a species of qualifying interest at the River Moy SAC may potentially be impacted as a result of the proposed development due to the drying out of 300m of the Eighnagh River for an average of 39 days. However, mitigation measures which include for monitoring and where required, capture and translocation of White-clawed crayfish are proposed to counteract these potential impacts. These are described in detail in **Section 5.5.3.2**.
Reduce diversity of the site?	No	The continued abstraction from Lough Talt at current rates has the potential to impact the local White-clawed crayfish population in the Eighnagh River. However, the overall diversity of the River Moy SAC is unlikely to be impacted.
Result in disturbance that could affect population size or density or the balance between key species?	No	The sustained abstraction of water from Lough Talt at current levels of operation may continue to affect White-clawed crayfish population size and density with the Eighnagh River which is designated as part of the River Moy SAC. However, mitigation measures which include for monitoring and where required, capture and translocation of White-clawed crayfish are proposed to counteract these potential impacts. These are described in detail in **Section**

Conservation Objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
		5.5.3.2.
Result in fragmentation?	No	The continued abstraction of water from Lough Talt at current levels of operation may influence the potential absence of water flow in 300m of the Eighnagh River for an average of 39 days. This dry flow event will isolate local White-clawed crayfish population in this section of the Eighnagh River resulting in the potential fragmentation of this species along the Eighnagh River s. However, mitigation measures which include for monitoring and where required, capture and translocation of White-clawed crayfish are proposed to counteract these potential impacts. These are described in detail in **Section 5.5.3.2**. The cessation of water abstraction during the decommissioning stage will affect surface water regime of the river outflow and will consequently result in a positive effect on the water dependent species of the River Moy SAC as naturally occurring drought conditions will not be exacerbated by the abstraction of 8MLD, and it is unlikely that the Eighnagh River will dry out annually thereby providing more habitat for aquatic species such as White-clawed Crayfish during drought conditions.
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding, etc.)?	No	Based on the size of the Moy catchment the potential absence of water flow in 300m of the Eighnagh River for an average of 39 days is unlikely to cause a significant change to the hydrological regime of the Moy catchment downstream. However, the continued abstraction of water from Lough Talt at current levels of operation may isolate (through the removal of key habitat) the localised white-clawed crayfish population in the Eighnagh River during drought conditions. Mitigation measures which include for monitoring and where required, capture and translocation of White-clawed crayfish along this section of the Eighnagh River are proposed to counteract these potential impacts. These are described in detail in **Section 5.5.3.2**. The cessation of water abstraction during the decommissioning stage will affect surface water regime of the Eighnagh River outflow from Lough Talt. The outflow to the river is proportional to the lake level so the cessation of the abstraction will initially lead to a slight increase in lake levels but ultimately will lead to increased outflows from the lake. The Eighnagh River has a 5%ile flow of 1.667 m^3/sec at a point approximately 500m downstream of the lake outfall. This corresponds to the flowrate that is exceeded 5% of the time. The increased discharge from the lake will increase this flow by 0.0925 m^3/sec or approximately 5.5%. For higher flow events and at points further downstream the effect will be even less. There is no history of flooding along this section of the river (www.floodmaps.ie) and as such the small increase in river flows is not expected to lead to any increase in flooding downstream.

5.7 NIS CONCLUSION

This Natura Impact Statement for the Lough Talt WTP upgrade has been carried out in accordance with Article 6 (3) of the 'Habitats' Directive 92/43/EEC. This Statement provides a professional scientific examination of the project and the relevant European sites (River Moy SAC and Lough Hoe Bog SAC), identifying and characterising any possible implications for the European site in view of the conservation objectives.

Robust and effective mitigation measures have been proposed during the construction stage of the project for the avoidance of impacts to Lough Hoe Bog SAC and the River Moy SAC. The implementation of best practice and construction design measures, site specific mitigation and those measures proposed in the Outline CEMP during the project's construction phase will retain all potential pollutants to within the bounds of the proposed WTP upgrade site.

Robust and effective mitigation measures have been proposed during the operation stage of the project for the avoidance of impacts to the River Moy SAC. Therefore, it can be concluded beyond reasonable doubt that the construction operation and decommissioning of the Lough Talt WTP upgrade will not have significant adverse effects on the conservation objectives of the River Moy SAC.

During the operation of the WTP upgrade, the sustained abstraction from Lough Talt at current rates will continue to impact *Vertigo geyeri*, a species of qualifying interest of Lough Hoe Bog SAC. However, the hydrological and hydrogeological mitigation measures described in **Section 5.5.3.1** will mitigate for potential adverse effects to the fen habitat which provides suitability *V. geyeri*. This mitigation will implement a combination of irrigation and monitoring to provide suitable habitat for *V. geyeri* to establish. However, the proposed measures will not mitigate for historical loss of the species due to abstraction pressures.

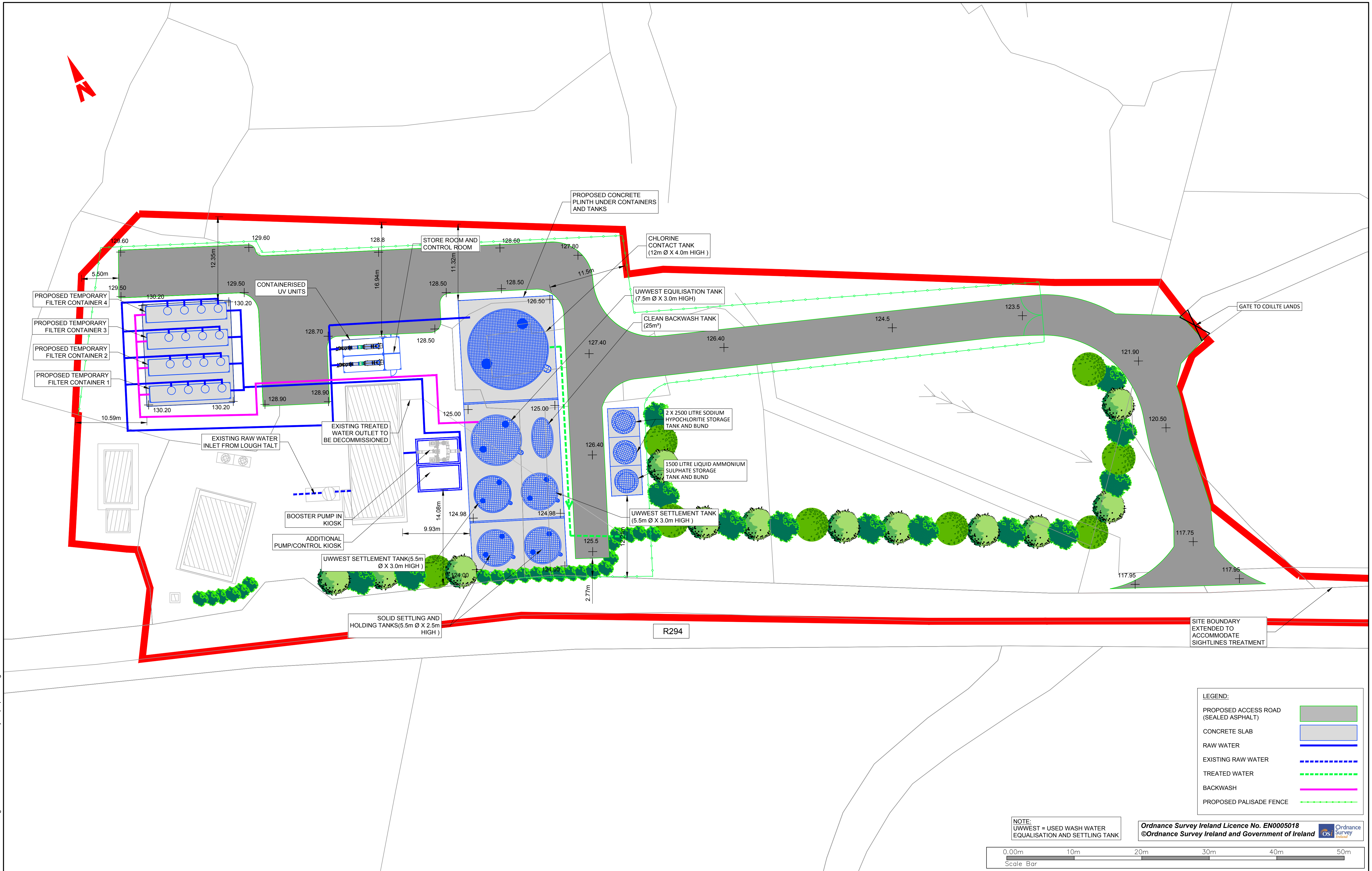
The conservation objectives for the Lough Hoe SAC are to 'maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected'. The current trends in conservation status[27] for Geyer's Whorl Snail (*Vertigo geyeri*) [1013] is 'declining', therefore the conservation objective is to 'restore'. *Vertigo geyeri* has not been recorded at the site since 2007; therefore continued abstraction from Lough Talt will cause delays in progress towards achieving the conservation objectives of the site for this species of qualifying interest.

Therefore, it cannot be concluded beyond reasonable doubt that the operation of the Lough Talt WTP upgrade will not have significant adverse effects on the conservation objectives, in particular *V. geyeri*, of Lough Hoe Bog SAC. The findings of the NIS (Stage 2 AA) confirmed that it was not possible to reduce impacts to acceptable, non-significant levels by avoidance and/or mitigation for historical loss of *V. geyeri* populations at Lough Talt. Therefore, Stage 3 of the Article 6 assessments must be undertaken which is to objectively assess whether alternative solutions exist by which the objectives of the plan or project can be achieved. Explicitly, this means alternative solutions that do not have negative impacts on the integrity of a European Site.

A number of replacement sources have been investigated and the Assessment of Alternative Solutions is presented in **Volume 2** of this report.

[27] NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Species Assessments Volume 3. Version 1.0. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

APPENDIX A - DRAWINGS



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Client

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Checked	PJG
Approved	PJG
Date	March 2018
Scale	1:250 @ A1 1:500 @ A3
Job No.	MGW0214

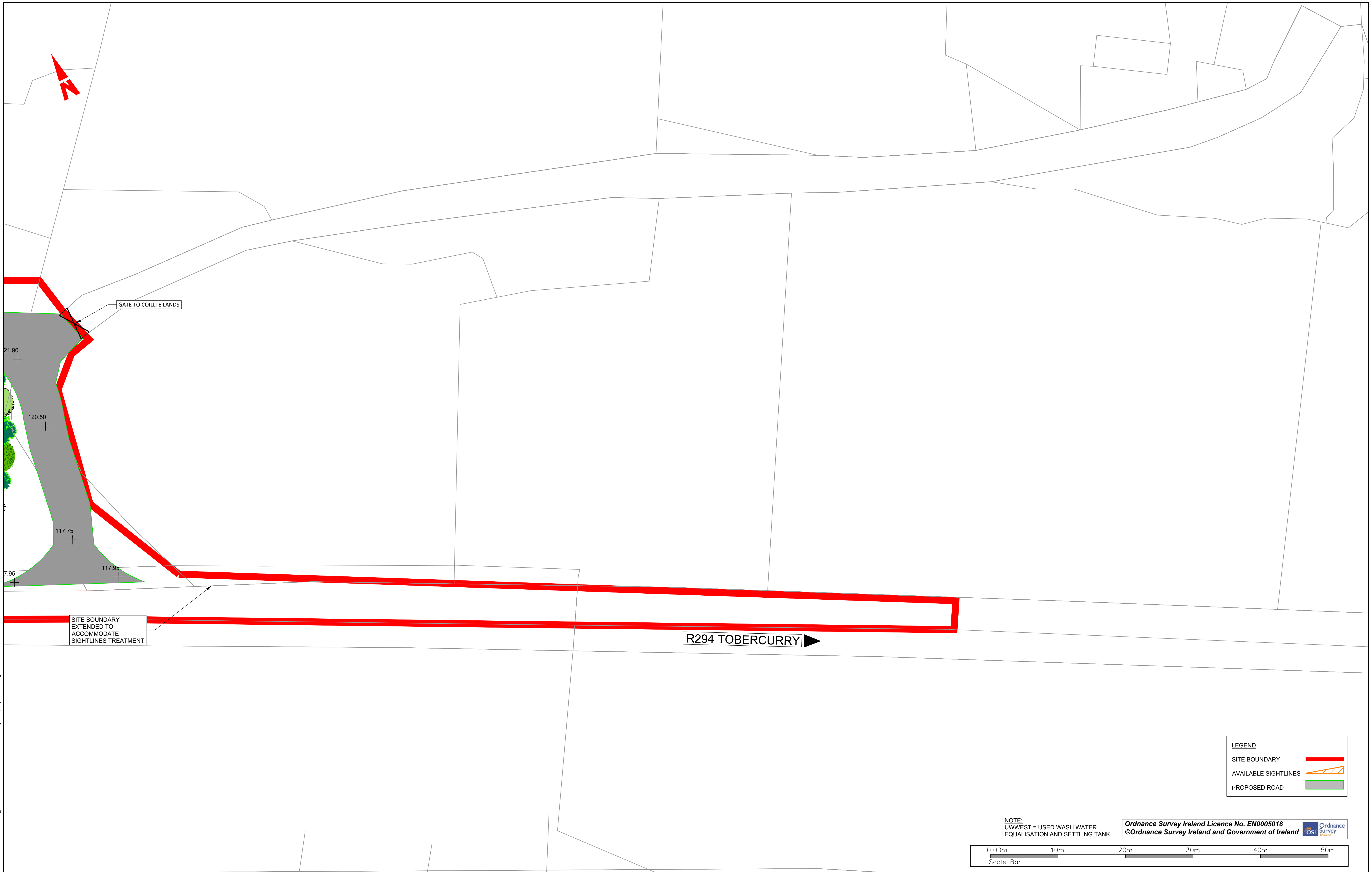
Project

LOUGH TALT REGIONAL WATER SUPPLY SCHEME - WATER TREATMENT PLANT UPGRADE

Title

PROPOSED SITE LAYOUT
(WATER TREATMENT PLANT)
Sheet 1

File Ref. MGW0214DG0016 | Drg. No. DG0016-01 | Rev. F01



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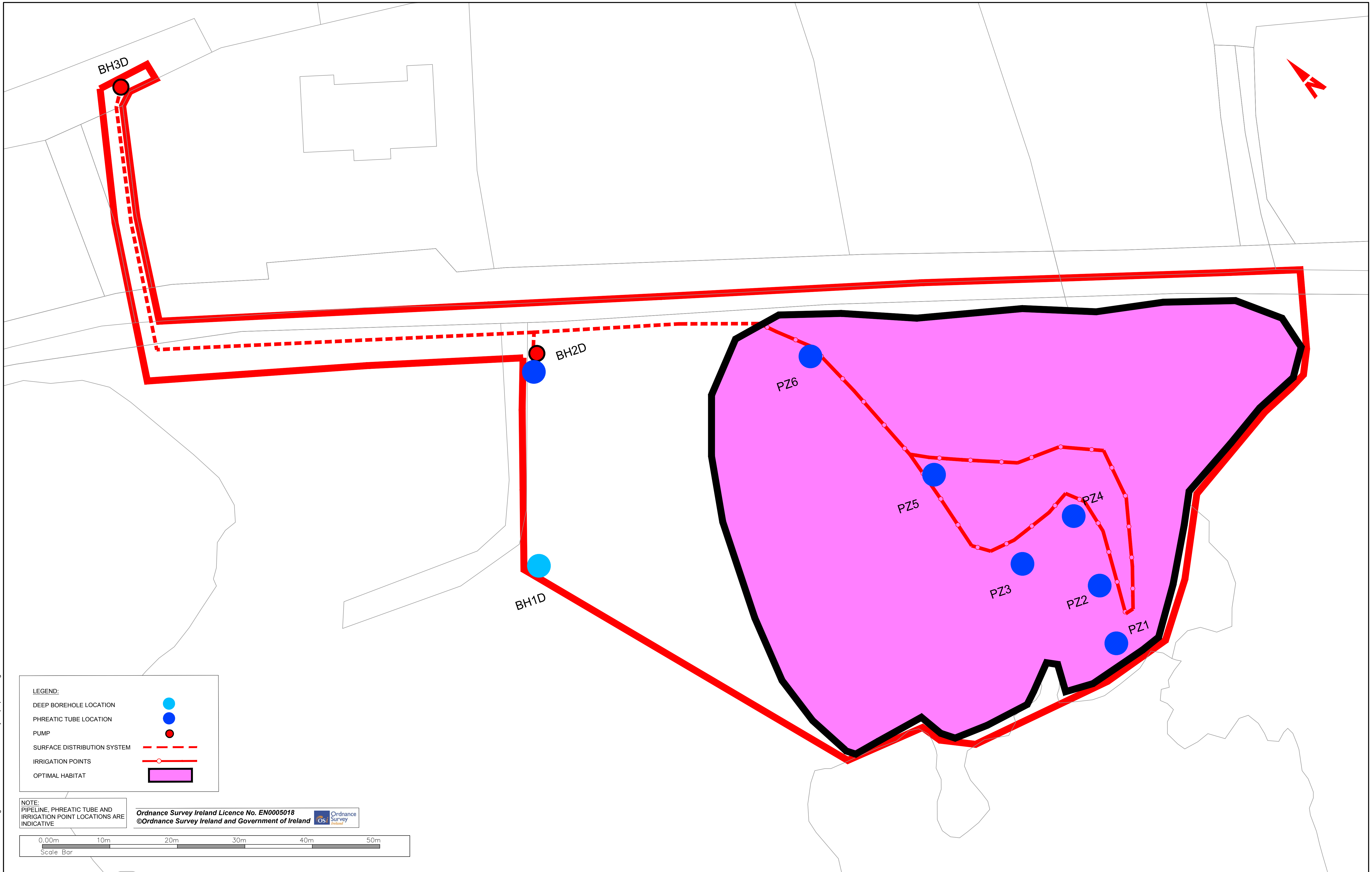
Approved	PJG
Date	March 2018
Scale	1:250 @ A1 1:500 @ A3
Job No.	MGW0214

Project
LOUGH TALT REGIONAL WATER SUPPLY SCHEME - WATER TREATMENT PLANT UPGRADE

Title
PROPOSED SITE LAYOUT
(WATER TREATMENT PLANT)
Sheet 2

File Ref. MGW0214DG0016 | Drg. No. DG0016-02 | Rev. F01



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Date	April 2018
Scale	1:250 @ A1 1:500 @ A3
Job No.	MGW0214

Project

LOUGH TALT REGIONAL WATER SUPPLY SCHEME - WATER TREATMENT PLANT UPGRADE

Title

PROPOSED SITE LAYOUT
MITIGATION MEASURES

File Ref. MGW0214DG0016 | Drg. No. DG0016-03 | Rev. F01

APPENDIX B – AQUATIC QUALITY ASSESSMENT

White-clawed crayfish survey (and general aquatic ecology assessment) of Lough Talt

22nd November 2016

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TABLE OF CONTENTS

1. INTRODUCTION

Ecofact Environmental Consultants prepared an Aquatic Ecology and Fisheries Assessment for the proposed Lough Talt Regional Water Supply Scheme (RWSS) in 2010 (Ecofact, 2010). The current report provides an updated White-clawed Crayfish survey assessment as well as an account of other aquatic macroinvertebrates and littoral aquatic flora. The current survey was completed in early October 2016.

Lough Talt is an oligotrophic/mesotrophic lake (designated habitat code 3110 Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)) situated in the Ox Mountains between Tobercurry and Ballina in Co. Mayo. Lough Talt is in the Moy catchment. The lake has a surface area of 90 hectares and a maximum depth of approximately 40m. Lough Talt forms part of the Lough Hoe Bog Special Area of Conservation (Site Code 000633). The outflow from the lake is called the Lough Talt River (also known as the Eighnagh River) which is also designated under the River Moy cSAC (Site Code 002298). A map of the study area showing Lough Talt and local watercourses is provided in Figure 1.

Lough Talt contains a substantial population of white-clawed crayfish *Austropotamobius pallipes*, a species also listed on Annex II of the EU Habitats Directive. Lough Talt is historically recognised as a good brown trout fishery and holds an Arctic char *Salvelinus alpinus* population, a rare and threatened species listed as vulnerable in the Irish Red Data Book for fish.

2. METHODOLOGY

Four sites on Lough Talt were surveyed during October 2016. The site locations are listed in Table 1 and are shown in Figure 1. These sites correspond to the lake sites previously surveyed in 2010 (Ecofact, 2010). These sites were selected in 2010 as being suitable representative sites with available access.

Table 1 Location of the sites examined on Lough Talt during October 2016.

Site	Aspect	NOS Grid Reference
L1	South shore adjacent to outfall	G4034, 1450
L2	South-west shore	G3993, 1455
L3	West shore	G3972, 1479
L4	North-east shore	G3945, 1568

2.1 White-clawed Crayfish

Surveying for White-clawed Crayfish was undertaken under licence from the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs (Licence No. C139/2016). Quantitative sampling of White-clawed crayfish was undertaken at 100 potential refuges at each of the 4 survey stations along the shore of Lough Talt. The hand search method used and followed that outlined in Reynolds *et al.* (2010). Prior to the survey all equipment used was sterilised for biosecurity purposes.

A total of 10 suitable habitat patches at each site were selected. Ten refuges were investigated per patch. Habitat considered to offer the best potential refuges was selected at each site. Apart from hatchlings, the total length and carapace length of captured Crayfish were measured using electronic vernier callipers.

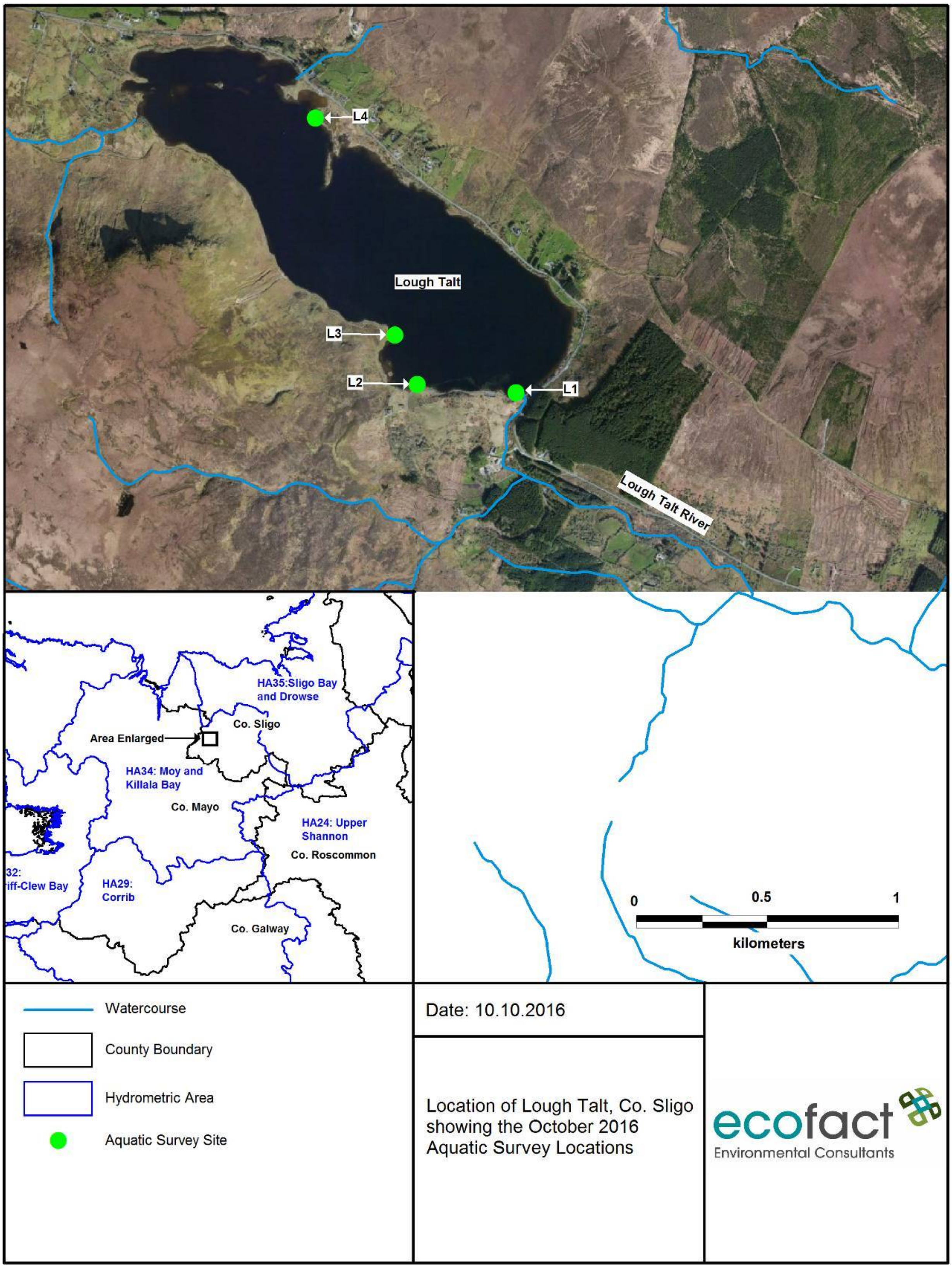

Figure 1 Location of the sites surveyed on Lough Talt during October 2016.

2.2 Other ecological indicators

Other littoral macro-invertebrates were sampled at the four sites around the lake from the shore to a depth of 1 meter. The sampling methodology described in the EPA manual by Irvine *et al* (2001) was followed. The invertebrates were collected via disturbing the substratum by 'kick sampling' and passing a hand net (mesh size 0.5 mm; 350 mm diameter) through the water above the disturbed area. All habitats in the chosen sampling site were sampled within a 3-minute period. In addition, a pre-sample sweep to collect surface dwelling invertebrates and a post sample manual search, lasting one minute, was undertaken during which any invertebrates attached to submerged plant stems, stones, logs or other solid surfaces were collected by hand and placed in the net.

All collections of invertebrates were combined for each site. Captured crayfish were counted and then released and all other invertebrates were sorted from debris on a white dissection tray and fixed in a 10% formalin solution. In the laboratory invertebrates were identified to the furthest practical taxonomic level using high-power and low-power binocular microscopes. Macroinvertebrates were identified using keys produced by the Freshwater Biological Association (see references section).

The results are presented as species lists and also biotic indices (BMWP and ASPT) were derived. These indices were designed for use in rivers, so are used for comparative purposes with previous studies only.

A general survey of littoral aquatic vegetation was also undertaken at each survey location. Submerged plants were photographed and small samples were collected for identification confirmation in the laboratory. Abundance of recorded plant species at each site was described using the qualitative DAFOR Scale (D=Dominant; A=Abundant; F=Frequent; O=Occasional; R=Rare).

Substrate conditions were also recorded during the course of the surveys.

3. RESULTS

3.1 Crayfish and other macroinvertebrates

3.1.1 Overview

White-clawed Crayfish were collected by hand searching in 100 potential refuges from the littoral zone of the four sites around the lake during early-October 2016. Table A1.1 gives the White-clawed Crayfish records for the four sites. Summary statistics of crayfish results are provided in Tables 2-4. Calm and bright weather conditions at the time of the surveys represented ideal conditions for surveying.

In general, a healthy white-clawed crayfish population was recorded at all sites surveyed on the lake. Hatchlings were present at all locations; evidence of successful recent reproduction. These hatchlings were not weighed or measured due to their small size and delicate nature. The highest number of individual hatchlings occurred along the south shore at Site L1 (N=9) and on the western shore at Site L2 (N=8). The largest crayfish was captured at Site L2. This specimen was male. The carapace length of this individual was 33.6 mm and the total length was 69.2mm. It is noted that layers of rock/cobble at some patches made finding smaller specimens difficult, as they could move deeper into the interstices upon detection of disturbance. To this end, it is likely that some Crayfish present in potential refuges were not detected/recorded.

Table 2 Abundance of White-clawed Crayfish (adult, hatchling and total), percentage male and female (excluding hatchlings) and Catch Per Unit Effort (CPUE) at four locations surveyed by hand searching on Lough Talt during October 2016.

Site	Post hatchling				Hatchling (N)	Total crayfish		% hatchlings
	N	% Male	% Female	$CPUE^1$		(N)	$CPUE^2$	
L1	20	40	60	0.20	9	29	0.29	31
L2	20	55	45	0.20	8	28	0.28	28.6
L3	26	50	50	0.26	6	32	0.32	18.8
L4	22	59.1	40.9	0.22	4	26	0.26	15.4

**CPUE Catch-Per-Unit-Effort: hand-searching of crayfish refuge.*
$CPUE^1$ refers to CPUE omitting hatchlings.
$CPUE^2$ refers to CPUE including hatchlings

Table 3 Summary statistics for carapace length (mm) for Crayfish captured during the October 2016 Survey on Lough Talt.

Site	N	Mean	Minimum	Maximum	St.Dev
L1	20	19.97	14.4	28.5	4.61
L2	20	23.93	13.4	33.6	5.96
L3	26	22.71	17	32	3.97
L4	22	22.84	15.2	31.1	4.32

Table 4 Summary statistics for total length (mm) for Crayfish captured during the October 2016 survey on Lough Talt.

Site	N	Mean	Minimum	Maximum	St. Dev
L1	20	41.43	29.2	58.5	9.5
L2	20	49.56	26.9	69.2	11.99
L3	26	46.98	34.5	67.3	8.67
L4	22	46.95	33	63.7	8.79

Other macroinvertebrates recorded at each location are listed in Table A1.2. Lough Talt supports a wide range of aquatic insects as depicted by the results. The species recorded at each location are a function of the habitats present and apparently good water quality. Collectively, three species of pollution sensitive mayfly were recorded during the surveys: these were larvae of *Heptagenia sulphurea, Heptagenia lateralis* and *Ephemera danica*. Mayfly larvae of *Caenis rivulorum* and *Centropitulum luteolum* were also recorded. White-clawed Crayfish were recorded at all locations.

Only one species of cased caddisfly was recorded: *Ceraclea nigronervosa.* Cases of Hydroptilidae were recorded at Site L3 but the larvae had recently hatched out. The caseless Trichopteran community was limited to larvae of *Polycentropus kingi* and *Plectronemia geniculata.*

Table 5 gives a biological water quality assessment of the study sites on Lough Talt. A broad range of macroinvertebrates are supported by the lake - a total of 24 families were recorded collectively across the four sites. Macroinvertebrate family richness ranged from 9 at Site L1 to 17 at Site L4. Greater macroinvertebrate diversity is associated with better water quality. The Biological Monitoring Working Party (BMWP) scores ranged from 57.6 at Site L2 (interpreted as moderately impacted) to 89.6 at L4 (interpreted as clean but slightly impacted). It is noted however that this biotic index was designed for flowing waters (fluvial/river habitats) so these interpretations are for demonstration and comparison with the 2010 results only.

Table 5 Biological water quality assessment of the study sites on Lough Talt.

Biotic index	Site			
	L1	L2	L3	L4
No. of different families	9	9	14	17
BMWP score	67.2	57.6	76.3	89.6
BMWP category	Moderate	Moderate	Good	Good
BMWP interpretation	Moderately impacted	Moderately impacted	Clean but slightly impacted	Clean but slightly impacted
ASPT	6.7	6.4	5.9	5.3

3.1.1 Results from individual sites

3.1.1.1 Site L1

Some large boulders also occurred along this part of the shore and were deemed to be important refuges for white-clawed crayfish. A total of 29 white-clawed crayfish were recorded in the 100 refuges examined along this part of the shore and included 9 hatchlings (31% of total). The CPUE at this location was 0.29 i.e. 0.29 crayfish per refuge examined. The mean carapace length was 19.97mm and the mean total length was 41.43mm for this site.

Macroinvertebrates in 9 different families were recorded at this location. The Ephemeroptera were well represented with larvae of pollution sensitive *H. sulphurea* and *E. danica* occurring as well as pollution tolerant *C. rivulorum.* Cased caddisfly larvae of *C. nigronervosa* was present, this species is associated with sponges. Caseless caddisfly larvae of *P. geniculata* were common at this location, as was the Crustacean *Gammarus duebeni*. The BMWP score for this site was 67.2 so is in the moderately impacted category.

3.1.1.2 Site L2

A total of 28 crayfish were recorded at this site. Refuges at sub-sites at the eastern end of the stretch comprised of large rocks and boulders. Towards the western end of the surveyed stretch, the substrate was dominated by sand and gravel and though there were some isolated rocks, refuges under these did not appear to be favoured by crayfish. A total of 8 hatchlings (28.6% of total) were captured at this site. The crayfish CPUE at this location was 0.28, with 55% of the total being males, and 45% females.

A macroinvertebrate family diversity of 9 was recorded at Site L2. The macroinvertebrate community at this location comprised largely of Orders Ephemeroptera, Diptera and Crustacea. Pollution sensitive mayfly larvae of *Heptagenia lateralis* and *E. danica* were scarce while *C. rivulorum* was present. True fly larvae of *Chironomous* sp. and green chironomids, and the Crustacea *G. duebeni*, *Asellus aquaticus* were generally common. The BMWP score for this site was 57.6 which is interpreted as moderately impacted.

3.1.1.3 Site L3

A total of 32 white-clawed crayfish were recorded at this site, the highest number out of the 4 sites. This site extended from the eastern tip of the headland to approximately 100 due west. Crayfish refuges mainly comprised rocks and some boulders. A total of 6 hatchlings were recorded accounting for 18.8% of the total catch. The CPUE for total crayfish at this location was 0.32. The mean carapace length was 22.71mm and the mean total length was 46.98mm for this site.

Macroinvertebrate family richness at Site L3 was 14. The most diverse group in the assemblage were the mayflies with Group A (pollution sensitive) *H. lateralis, H. sulphurea* and *Ephemera danica* as well as *C. luteolum* and *C. rivulorum* recorded. Caseless larvae of the trumpet-net caddisflies *P. kingi* and *P. geniculata* were present along with the larval *Ischnura elegans* damselfly. Two species of Crawling water beetle were present at this site: *Haliplus flavicollis* and *H. confinis*. The BMWP score for this site was 76.3 so is in the clean but slightly impacted category.

3.1.1.4 Site L4

A total of 26 crayfish were recorded in the 100 refuges searched along the stretch of approximately 100m at this location. This represents a CPUE of 0.26. A relatively small fraction of the total catch were hatchlings (15.4%). The substrate in the stretch examined was typically of cobble with the exception of the southern end of the stretch which comprised a large proportion of gravel with only some rock and cobble present. Out of the 4 sites surveyed, Site L4 had the highest percentage of males captured (59.1%).

A wide range of aquatic macroinvertebrates were recorded at Site L4, where 17 families were documented in a variety of habitats. Mayfly larvae of *E. danica* were common with *C. rivulorum* (small numbers) and *C. luteolum* (scarce) also recorded. The Molluscs were a well-represented group at this site with the snails *Planorbis carinatus, Potamopyrgus antipodarium* and *Lymnaea stagnalis,* and the orb mussel *Pisidium* sp. generally scarce. Fair numbers of the Hemiptera *Gerris* sp. were recorded while Corixidae were present. Whirligig beetle larvae of *Gyrinus* sp. were present as well as adult *H. flavicollis.* Other species recorded here were the leech *Piscicola geometra* and Dipteran larvae of *Tipula* sp. and Tabanidae.

3.2 Aquatic plants

The aquatic flora recorded at each site is given in Table 6 below. Canadian waterweed *Elodea canadensis*, Alternate Water-milfoil *Myriophyllum alterniflorum,* Stonewort *Nitella sp.,* Shoreweed *Littorella uniflora* and Filamentous Algae were recorded at the four survey sites.

Table 6 Aquatic flora recorded at each site surveyed in Lough Talt in October 2016.

Site	L1	L2	L3	L4
Canadian Waterweed *Elodea canadensis*	*R*			
Alternative Water-milfoil *Myriophyllum alterniflorum*		*R*		
Stonewort *Nitella sp.*		*R*	*R*	*F*
Shoreweed *Littorella uniflora*				*A*
Filamentous Algae	*A*	*D*	*A*	*O*
Freshwater Sponge *Spongilla lacustris*	*R*			

*DAFOR Scale: D=Dominant; A=Abundant; F=Frequent; O=Occasional; R=Rare.

Canadian waterweed *Elodea canadensis* is a non-native, invasive aquatic plant that is usually completely submerged under water. Dense growth of this species can replace native aquatic plant species and reduce biodiversity in lakes and ponds. It is a shallow rooted plant found in mesotrophic and eutrophic still and slow flowing waters. It prefers high levels of silt but can tolerate a range of mineral conditions and can persist in anaerobic substrates. Canadian waterweed was only present at Site 1. The substrate at this site consisted mainly of rock, abundant in filamentous algae, therefore there was little silt habitat present for plant roots. Only one strand was found at this site, leading to the assumption that this species is rare in Lough Talt.

Alternate Water-milfoil *Myriophyllum alterniflorum* is a native aquatic plant usually found in mesotrophic or oligotrophic waters. Site 2 mainly consisted of rocky substrates but in a small area of silt it was found in a cluster on the lake bed, therefore it was a rare occurrence in the surveyed area. This species is a typical species for the [3110] 'Oligotrophic waters containing very few minerals of sandy plains' habitat (O Connor, 2015).

Stonewort *Nitella sp.* was found at Sites 2, 3, and 4. Sites 2 and 3 mainly consisted of rocky substrates where *Nitella sp*. was rare but it was recorded on the lake bed in between rocks. This species was frequent at Site 4, likely due to the fact that the substrate comprised of more cobble and sandy areas suitable for plant roots. Along the shore at Site 4 there was a considerable amount of dried Stonewort that had been washed up. *Nitella sp.* is usually found growing in shallow to deep waters or soft water or acid lakes or bogs. It frequently forms a thick carpet or grow in clumps along the bottom. Some species of *Nitella* (*Nitella translucens, Nitella opaca, Nitella confervacea)* are listed as typical species for the 3110 annexed habitat (O'Connor, 2015).

Shoreweed *Littorella uniflora* is a native aquatic flora species found on lakeshores, loughs and reservoirs on mud, sand or gravel and in oligotrophic or mesotrophic waters. It can occur over a wide range of substrates including stones, gravel, sand, peat, marl and soft mud. In Ireland it is most frequent in areas of base-poor rocks and waters, but it can grow in base-rich habitats such as in clear limestone lakes. The presence of Shoreweed *Littorella uniflora* is a characteristic species of the 3110 habitat. This plant was found to be frequent at site 4. The substrate at this site consisted mainly of cobble, with areas of sand suitable for plant roots.

Filamentous Algae was the dominating flora found at Lough Talt. Sites 1, 2 and 3 consisted of some rocky substrates that were covered in filamentous algae, making it very slippery and difficult to walk. Freshwater Sponge *Spongilla lacustris* was recorded on a rock at Site 1, and not seen in any other area surveyed.

In order of increasing depth, the aquatic plants recorded in the littoral zone of Lough Talt were Shoreweed, Freshwater Sponge, Canadian Pondweed and Alternative Water-milfoil. Filamentous algae was recorded to depths up to 1.5m and but growth was more luxuriant in the shallows. Shoreweed was recorded at the transition of the lake and the lake shore and to depths of ca. 15cm in gravel/sand/silt substrates. Canadian Pondweed was recorded near the lake outflow at a depth of ca. 0.5m. It is noted that the current survey was limited to four shallow littoral areas where the substrate comprised mainly of rock and cobble. These sites were selected as white-clawed crayfish monitoring sites.

4. CONCLUSIONS

During the current significant numbers of white-clawed crayfish were again recorded at the 4 monitoring sites. However, the CPUE had declined at all sites and the % of hatchlings present was also lower during the October 2016 survey when compared with the 2010 survey. Both surveys were undertaken in similar environmental conditions in early Autumn - lake levels and weather conditions were similar during both surveys. Both surveys were completed by the same surveyors using the same methods.

The current survey also suggests that a significant decline in numbers has taken place since a survey completed in August 2007 (O'Connor *et al*. 2009). It is noted that a CPUE1 of 0.47 was recorded in 2007, while the overall CPUE1 was 0.32 in 2010 but had declined to 0.22 in the current survey. It is noted that the 2007 survey had just one site and this was located at Site L2. Although the CPUE1 recorded at this site was much lower than the 2007 survey it is similar to the 2010 survey (0.19 in 2010 and 0.20 in the current survey). There is however an indication of an overall decline from the data and this would require further investigation. The reason for this apparent decline, and its significance in relation to the conservation status of this species in the Lough Hoe Bog SAC, is unknown. It is noted that 0.20 remains a high CPUE level with reference to the 26 lakes (13 with crayfish) surveyed in 2007. It can be expected that natural variation in numbers would occur as a result of natural background environmental variations. However, crayfish numbers could also be affected by a decline in water quality or due to fluctuations in water levels. During the course of the current survey, substrates were found to have a significant cover of algae and silt. It is considered that some enrichment of Lough Talt may have taken place since the last survey. A possible source of nutrients (and silt) could be from the steep sided hills in the Lough Talt catchment, many of which are over-grazed by sheep and are actively eroding. Increased algae cover could also potentially have affected sampling efficiency. The 2007 survey was undertaken in August, with the other surveys undertaken a month or more later, so sampling time could have also played a role. It is recommended that further monitoring be undertaken, to include monitoring of water levels and water chemistry.

In Irish lakes, adult White-clawed Crayfish prey on a wide variety of benthic invertebrates including snails, crustaceans and insect larvae, controlling the abundance of some species (Matthews and Reynolds, 1992). In White Lake, Co. Westmeath, sub-yearlings fed chiefly on small entomostracan crustacea and insect larvae while larger crayfish fed predominantly on charophytes (stoneworts), and the largest ate a significant proportion of both dead terrestrial vegetation (deciduous leaves) and juvenile crayfish. The diversity of the macroinvertebrate community recorded in Lough Talt during the current survey signifies good water quality. The BMWP scores at each site have increased when compared to the previous assessment. Macroinvertebrates are considered an important component of the diet of Crayfish hatchlings and juveniles in the Lough Talt and the results suggest sufficient food source and quality for Crayfish.

Lough Talt is designated as an Annex I Habitat 'Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3110]. Plants indicative of this habitat were recorded during the aquatic assessment. However, overall, there was little aquatic flora present at the four sites surveyed. In lakes, freshwater crayfish are recognised as ‘keystone’ species which have measurable impacts on benthic fauna and macrophytes (Reynolds, 1998). Calcified plants such as charophytes are attractive to crayfish as they offer a ready source of calcium during the moulting process (Holdich, 2003).

PLATES

Plate 1 Site 1 was located on the southern shore of Lough Talt.

Plate 2 Site 2 was located on the south-western shore of Lough Talt.

Plate 3 Site 3 was located on the western shore of Lough Talt along the northern shore of a small cape that extends out into the lake.

Plate 4 Site 4 was located at the western end of the headland near the car park at Gleneask on the north-eastern shore of the lake.

Plate 5 Lough Talt outflow adjacent to Site 1.

Plate 6 Surveying for Crayfish by hand searching (snorkelling).

Plate 7 Kick sampling using a dip net was used to sample macroinvertebrates along the littoral margins of the lake.

Plate 9 Sorting macroinvertebrate sample on-site.

Plate 9 Crayfish carapace length measurement using digital Vernier calipers.

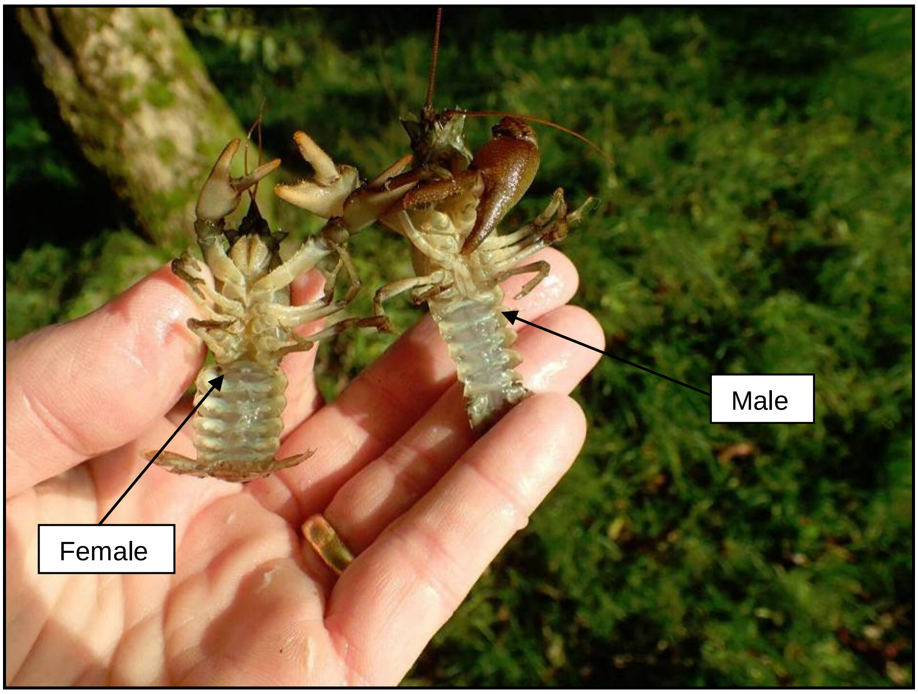

Plate 10 Male (Right) and Female (Left) Crayfish captured during survey.

Plate 11 White-clawed Crayfish hatchling recorded during a hand search of a cobble refuge at Site 2t.

Plate 12 Adult white-clawed crayfish at Site L2.

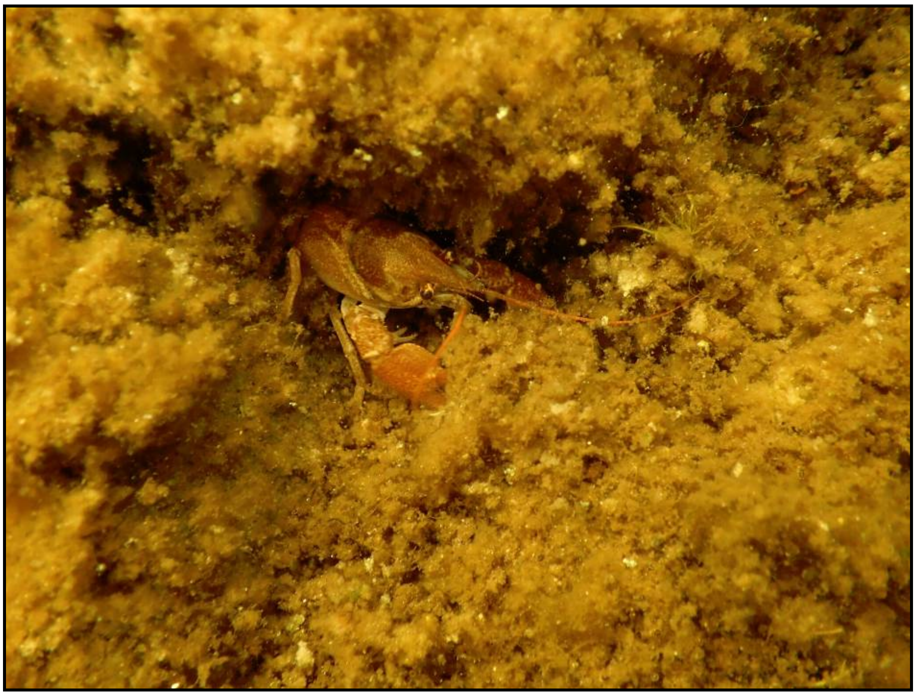

Plate 13 Adult White-clawed Crayfish seen here alongside its refuge.

Plate 14 Mayfly larvae *Ephemera danica*.was recorded at all four survey locations.

Plate 15 *Ceraclea nigronervosa* (a cased caddisfly larvae) was recorded at Site L1.

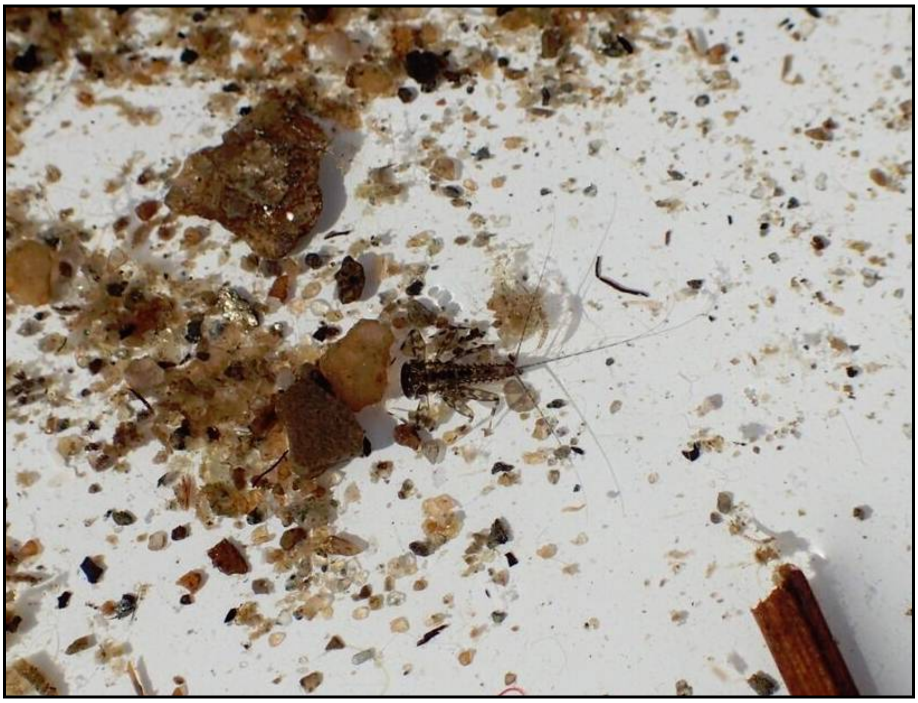

Plate 16 *Heptagenia sulphurea* (a mayfly larvae) – this species was recorded at Sites L1 and L3.

Plate 17 Stonewort *Nitella sp.* was found at Sites 2, 3 and 4.

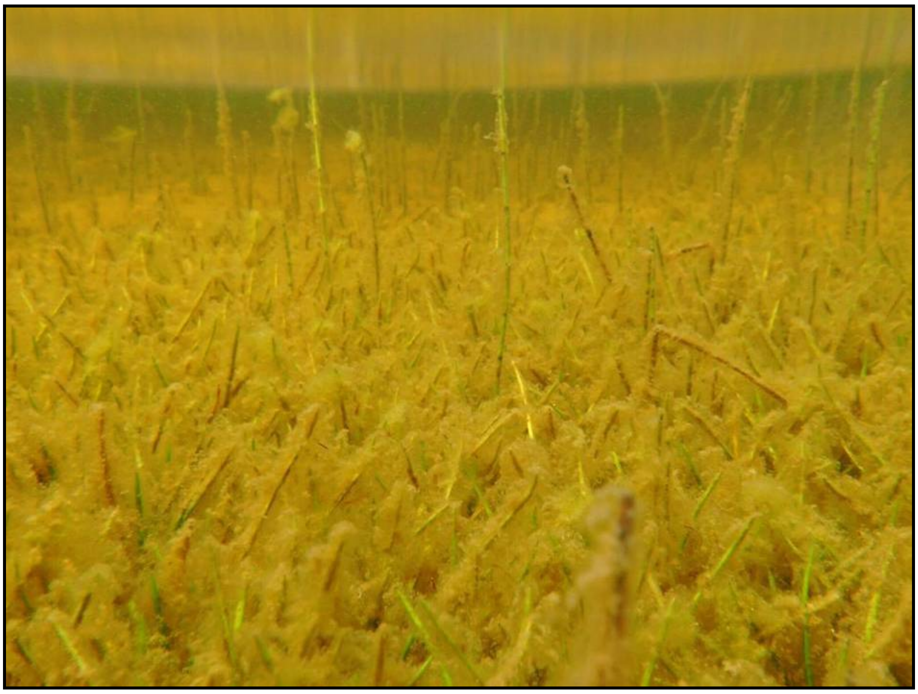

Plate 18 Shoreweed *Littorella uniflora* was present at Site 4.

Plate 19 Freshwater sponge *Spongilla lacustris*.

Plate 20 Canadian waterweed *Elodea canadensis* (invasive).

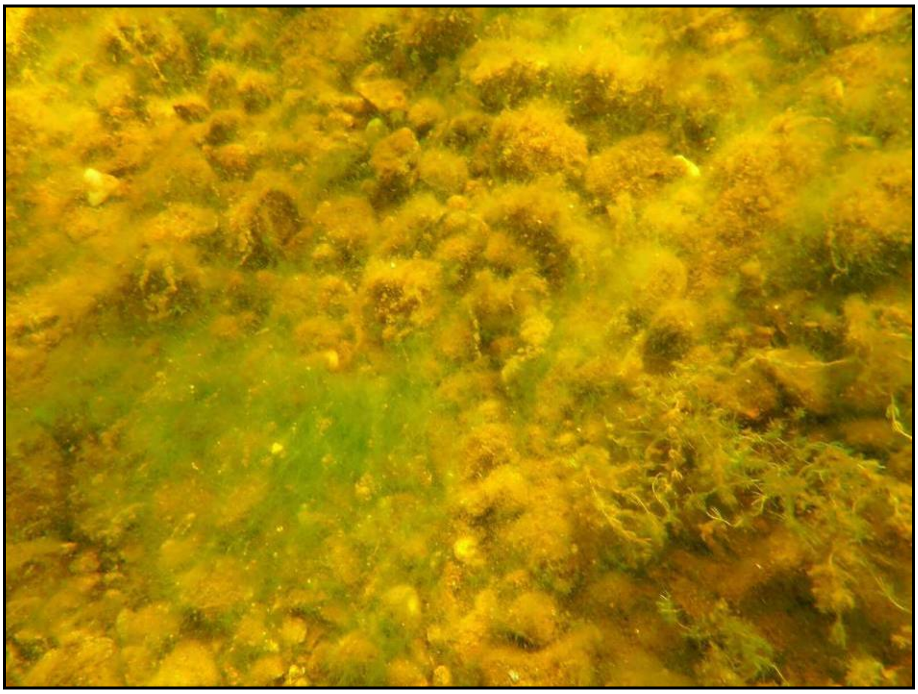

Plate 21 Stonewort *Nitella sp.* and algal growth substrate in Lough Talt at Site L1.

Plate 22 Alternate Water-milfoil *Myriophyllum alterniflorum*.

REFERENCES

Edington J.M. & A.G. Hildrew (1995) A Revised Key to the Caseless Caddis Larvae of the British Isles, with Notes on their Ecology 1995, 134pp.

Elliott J.M. & K.H. Mann (1979) A Key to the British Freshwater Leeches, with Notes on their Life Cycles and Ecology. 1979 (reprinted 1998), 72pp.

Elliott J.M. & U.H. Humpesch (1988) A Key to the Larvae of the British Ephemeroptera, with Notes on their Ecology1983, 101pp + 1 plate.

Gledhill, T., D.W. Sutcliffe & W.D. Williams (1993) British Freshwater Crustacea Malacostraca: a Key with Ecological Notes 1993, 176pp.

Holdich D (2003). Ecology of the White-clawed Crayfish. Conserving Natura 2000 Rivers Ecology Series No. 1. English Nature, Peterborough.

Hynes H.B.N. (1977) A Key to the Adults and Nymphs of the British Stoneflies (Plecoptera), with Notes on their Ecology and Distribution. Third edition, 1977 (reprinted 1993), 92pp.

Macan T.T. (1994) A Key to the British Fresh- and Brackish-Water Gastropods, with Notes on their EcologyFourth edition, 1977 (reprinted 1994), 46pp.

Matthews, M.A. & Reynolds, J.D., (1992) Ecological impact of crayfish plague in Ireland. Hydrobiologia, 234, 1-6.

Nilsson, A.N. [ed.], (1997). Aquatic Insects of North Europe, A Taxonomic Handbook. 2. Apollo Books Aps., Stenstrup: 440 pp.

O Connor, Á. (2013) Article 17 assessment form and audit trail for *Najas flexilis*, the Slender Naiad (species code 1833). Backing Document. April 2013. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland.

O'Connor, W., Hayes G., O'Keeffe, C. & Lynn, D. (2009) Monitoring of white-clawed crayfish *Austropotamobius pallipes* in Irish lakes in 2007. *Irish Wildlife Manuals,* No 37. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

Preston, C.D., and Croft, J. M., 1997. Aquatic plants in Britain and Ireland. Harley Books. Colchester.

Preston, C. D., Pearman, D. A. and Dines, T. D., eds (2002). *New Atlas of the British and Irish Flora*. Oxford University Press, Oxford.

Reynolds, J. D. (2006) Manual for monitoring Irish lake stocks of white-clawed crayfish, *Austropotamobius pallipes* (Lereboullet). Unpublished report to NPWS.

Reynolds, J.D., O'Connor, W., O'Keeffe, C. & Lynn, D. (2010) A technical manual for monitoring white-clawed crayfish *Austropotamobius pallipes* in Irish lakes. Irish Wildlife Manuals, No 45, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

Savage A.A. (1989) Adults of the British Aquatic Hemiptera Heteroptera: a Key with Ecological Notes1989, 173pp.

Savage A.A. (1999) Keys to the Larvae of British Corixidae1999, 56pp.

Stace, C. (1997) *New flora of the British Isles*. Cambridge University Press, London.

Walley W.J. and Hawkes H.A. (1997) A computer-based development of the Biological Monitoring Working Party score system incorporating abundance rating, biotope type and indicator value. *Water Research*, 31 (2), 201-21.

Wallace, I.D., B. Wallace & G.N. Philipson (2003) Keys to the Case-bearing Caddis Larvae of Britain and Ireland 2003, 259pp.

Webb, D. A., Parnell, J. & Doogue, D. (1996) *An Irish Flora*. Dundalgan Press, Dundalk.

Table A1.1 White-clawed Crayfish records for the four sites surveyed by hand searching on Lough Talt during October 2016.

Site	Carapace Length (mm)	Total Length (mm)	Sex and notes
L1	28.5	58.5	M
	25.4	54.9	F
	25.6	52.2	F
	21.8	45.4	F
	27.9	55.4	M
	25	52.7	F
	20.7	44.2	F
	21.6	44.7	M
	17.8	36.9	M
	23.8	49.1	M
	16.3	34.9	F
	16.5	34.5	F
	16.8	35.9	F
	16.4	32.6	F
	17	35.2	M
	15.5	31.6	M
	17.5	36.3	M
	16.3	34.5	F
	14.4	29.2	F
	14.6	29.9	F
L2	33.6	69.2	M
	22.1	46.7	F
	25.8	54.7	F
	27.8	56	M
	29.8	60.3	M
	28.3	57.7	M
	24.9	51.3	M
	29.5	61.4	M
	33.5	68.5	M
	21.6	43.8	M
	21	43.3	F
	20.5	43	F
	27.1	56.9	F
	29.2	60.8	M
	19.3	40.1	F
	21.7	43.8	M
	19.4	41.4	F
	16.4	35.5	F
	13.7	29.8	M
	13.4	26.9	F
L3	32	67.3	F
	17	35.6	M
	26.6	53	M
	26.7	54.5	M
	18.2	34.5	M (Recently Moulted)
	24.5	52.3	F
	25.6	50.6	M
	21.9	49.2	F
	22.9	47.9	F
	23.4	50.7	F
	24.9	53	F
	27.6	56.7	M
	25.2	52.6	F
	18.5	37.6	F

Site	Carapace Length (mm)	Total Length (mm)	Sex and notes
	27.2	57.2	F
	26.5	56.5	F
	23.9	49.3	F
	23.1	47.5	M
	22.2	45.9	F
	17.7	36.4	M
	17.2	34.9	M (Recently Moulted)
	23.1	45.9	M
	18.1	36.9	M
	18.4	38.2	F
	18.5	38.5	M
	19.6	38.9	M
L4	25.8	55.6	F
	22	45.7	M
	31.1	63.7	M
	30.5	61.2	M
	24.7	50.1	F
	22.2	36.7	F
	23.5	49.3	M
	26	52.9	M
	26.2	55	F
	23.8	48.9	M
	24.6	51.2	M
	27.1	55.5	M
	24.7	51.9	M
	20.9	43.2	M (Recently Moulted)
	20.9	41.2	M
	21.4	43.6	M
	21.9	46.1	F
	16	33.2	F
	15.2	35	F
	16	33	M
	16.6	35.5	F
	21.4	44.4	F

Table A1.2 Macroinvertebrates recorded during biological sampling carried out on Lough Talt during October 2016.

	Pollution sensitivity group	Functional group	Site			
			L1	L2	L3	L4
MAYFLIES (Uniramia, Ephemeroptera)						
Family Heptagenidae						
Heptagenia sulphurea	A	Scraper & gathering collector	**		*	
Heptagenia lateralis	A	Scraper & gathering collector		**	*	
Hexes and big drakes (Ephemeridae)						
Ephemera danica	A	Filtering collector	***	**	*	*****
White midges (Caenidae)						
Caenis rivulorum	C	Gathering collector	*	*	**	***
Baetidae						
Centropitulum luteolum	B	Gathering collector			*****	**
CASED CADDIS FLIES (Trichoptera)						
Long-horned caddisflies (Leptoceridae)						
Ceraclea nigronervosa	B	Scraper	*			
CASELESS CADDIS FLIES (Trichoptera)						
Trumpet-net caddisflies (Polycentopodidae)						
Plectronemia geniculata	C	Filtering collector	*****	**	**	*
Polycentropus kingi	C	Filtering collector			*	
DAMSELFLIES (Odonata, Zygoptera)						
Red and blue damselflies (Coenagriidae)						
Common bluetip *Ischnura elegans*	B	Predator			*	*
TRUE FLIES (Diptera)						
Craneflies (Tipulidae)	C	Shredder				
Tipula sp.	C	Shredder			*	
Family Chironomidae						
Bloodworm *Chironomous* sp.	E	Filtering collector		****	*	**
Green chironomid	C	Filtering collector		*****	***	****
Horsefly larvae (Tabanidae)	C	Collector				*
Ceratopogonidae	C	Collector			*	
BEETLES (Coleoptera)						
Whirligig beetle larvae (Gyrinidae)	C	Predator				
Whirligig beetle *Gyrinus* sp.	C	Predator				*
Crawling water beetles (Haliplidae)						
Haliplus confinis	C	Predator			*	
Haliplus flavicollis	C	Predator			*	*
SNAILS (Mollusca, Gastropoda)						
Family Lymnaeidae						
Great pond snail *Lymnaea stagnalis*	C	Shredder				*
Family Planorbiidae						
Keeled Ramshorn Snail *Planorbis carinatus*	C	Scraper				***
Family Hydrobiidae						
Jenkin's spire shell *Potamopyrgus antipodarium*	C	Scraper	***		**	**
MUSSELS (Mollucsa, Lamellibranchiata)						
Orb/Pea Mussels (Sphaeridae)	D	Filtering collector				

	Pollution sensitivity group	Functional group	Site			
			L1	L2	L3	L4
Pisidium sp.	D	Filtering collector				**
CRUSTACEANS (Crustacea)						
Amphipods (Amphipoda, Gammaridae)						
Freshwater shrimp *Gammarus duebeni*	C	Shredder	*****	******	***	****
Isopods, Asellidae						
Asellus aquaticus	D	Shredder		****	*	
Astacidae						
White clawed crayfish *Austropotamobius pallipes*	C	Predator & scraper	**	**	***	**
LEECHES (Hirudinae)						
Piscicolidae						
Piscicola geometra	C	Predator				*
BUGS (Hemiptera)						
Broad shouldered water skaters (Gerridae)						
Gerris sp.	C	Predator				*
Lesser water boatman (Corixidae)	C	Predator				****
SEGMENTED WORMS (Annelida, Clitellata)						
Aquatic earthworm (Lumbricidae)	D	Gathering collector	*	*		

**Present (1 or 2 individuals), **Scarce/Few (<1%), ***Small Numbers (<5%), ****Fair Numbers (5-10%), *****Common (10-20%), ******Numerous (25-50%), *******Dominant (50-75%), ********Excessive (>75%).*

APPENDIX 2 Results from 2010 survey

Table A2.1 Abundance of white-clawed crayfish (adult, hatchling and total), percentage male and female (excluding hatchlings) and Catch Per Unit Effort (CPUE) at four locations surveyed by hand searching on Lough Talt during September 2010.

Site Location	Post hatchling (N)	% Male	% Female	$CPUE^1$	Hatchling (N)	Total crayfish (N)	$CPUE^2$	% hatchlings
L1 (south shore)	32	53.1	46.9	0.32	11	43	0.43	34
L2 (south western shore)	19	42.1	57.9	0.19	12	31	0.31	63
L3 (western shore)	26	42.3	57.7	0.26	12	38	0.38	46
L4 (north eastern shore)	51	60.7	39.3	0.51	6	57	0.57	12

**CPUE Catch-Per-Unit-Effort: hand-searching of crayfish refuge.*
$CPUE^1$ refers to CPUE omitting hatchlings
$CPUE^2$ refers to CPUE including hatchlings

Table A2.2 Summary statistics for weight (g) for crayfish captured during the September 2010 survey on Lough Talt.

Site location	N	Mean	Minimum	Maximum	St.Dev
L1 (south shore)	32	2.44	0.5	7	1.91
L2 (south western shore)	19	3.94	0.9	12.1	2.99
L3 (western shore)	26	4.288	0.7	24.2	4.84
L4 (north eastern shore)	51	3.32	0.2	9.7	2.122

Table A2.3 Summary statistics for carapace length (cm) for crayfish captured during the September 2010 survey on Lough Talt.

Site location	N	Mean	Minimum	Maximum	St.Dev
L1 (south shore)	32	2.13	1.38	7.2	1.034
L2 (south western shore)	19	2.28	1.35	3.4	0.58
L3 (western shore)	26	2.23	1.28	4.3	0.72
L4 (north eastern shore)	51	3.18	0.93	26.5	4.69

Table A2.4 Summary statistics for total length (cm) for crayfish captured during the September 2010 survey on Lough Talt.

Site location	N	Mean	Minimum	Maximum	St.Dev
L1 (south shore)	32	4.12	2.63	5.95	0.95
L2 (south western shore)	19	4.81	2.8	6.9	1.15
L3 (western shore)	26	4.79	2.88	8.7	1.39
L4 (north eastern shore)	51	4.63	2.05	6.51	0.99

APPENDIX C – ASSESSMENT OF VERTIGO GEYERI HABITAT

ASSESSMENT OF *VERTIGO GEYERI* HABITAT AT LOUGH TALT, COUNTY SLIGO WITH REFERENCE TO THE INTEGRATION OF MICROTOPOGRAPHY AND MICROHABITAT CONDITION TO INTEGRATE WITH HYDROLOGICAL MONITORING

September 2016

Evelyn A. Moorkens

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Ireland.

Evelyn Moorkens
& Associates

1.0 Introduction

The small whorl snail *Vertigo geyeri* has a population recorded in the north east fen-marsh lake shore spring-seepage slopes, with sedge-rich, mossy seepage zones in open situations. The EU habitats present at the site are Alkaline fens: low sedge-rich communities (Annex I Habitat 7230), and rich fens of CORINE 54.2 (Romão, 1996; Devillers *et al*., 1991). This falls within the more general habitat of rich fen and flush (PF1) of Fossitt (2000), as described in Moorkens & Killeen (2011).

The specific areas that support *V. geyeri* are within a wider mosaic of heather hummocks and denser vegetation, and are specific to emergent seepages, where they typically fit the characteristic vegetation classification within the Caricion davallianae alliance, characteristically being distinguished by *Carex viridula, Parnassia palustris, Campylium stellatum, Drepanocladus revolvens, Orchis mascula, Eleocharis quinqueflora, Pinguicula vulgaris, Carex panicea, Schoenus nigricans, Briza media, Succisa pratensis, Equisetum palustris, Mentha aquatica, Hydrocotyle vulgaris,* and *Menyanthes trifoliata* (Rodwell, 1991).

A total of 27 molluscan species have been recorded in the general area of the spring seepages, with 14 key indicator species being present in good numbers, including *Vertigo geyeri*. However, *Vertigo geyeri* was not found in surveys since 2007.

An appropriate micro-habitat regime is a key requirement for the spring-seepage habitat to function to a level that will support *V. geyeri* and the many species that are protected under the umbrella of a habitat with this function. A hydrogeological study was initiated, relating the essential habitat for the snail with the wider hydrogeological profile and function. This was carried out by drilling three deep and shallow monitoring boreholes at the edge of the fen area, and placing six shallow piezometers within the *V. geyeri* habitat area (RPS, 2014). The suite of piezometers were placed to ensure they were relevant to the snail habitat, but not exactly in key habitat areas in order to avoid direct damage to the spring/seepage habitat function.

More detailed information is required to understand the range of lake fluctuations that would remain protective to the function of the habitat of *V. geyeri* at Lough Talt.

To provide more accurate information, it was proposed to install loggers in all six piezometers, and to relate the logged water level information with the exact conditions of the *V. geyeri* habitat, by measuring the micro-topography range within the habitat and to assess the function of the habitat during a wet and a dry part of the annual hydrological fluctuation.

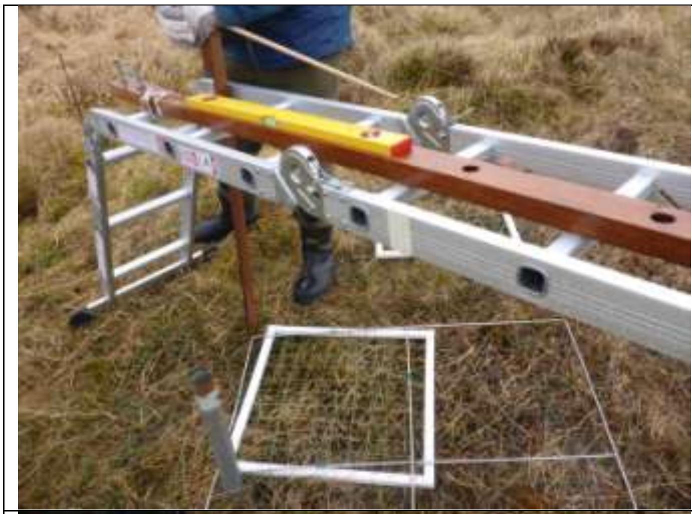
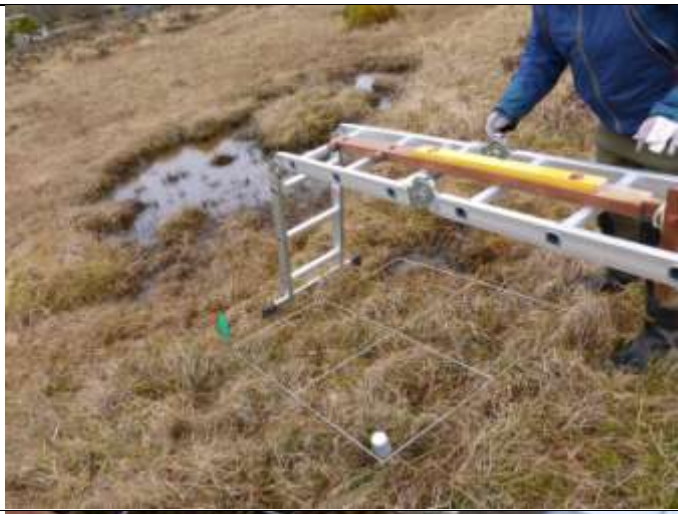
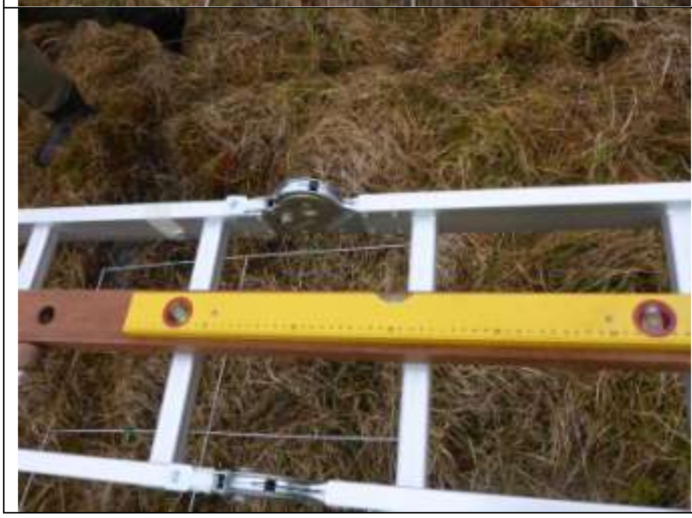
2.0 Methodology

2.1 Topographic measurements

Each site was surveyed with the use of a 1m x 1m stainless steel quadrat sub-divided into 4 0.5m x 0.5m sub-quadrats. The position of each quadrat was set up such that the dipwell was in one corner. A green flag was placed in one other corner to allow for accurate relocation.

A plastic quadrat sub-divided into one hundred 5cm x 5cm squares was then placed within each of the four sub-quadrats within the 1m x 1m quadrat.

A multi-jointed ladder was set up over the quadrat and levelled accurately with the aid of a large spirit level equipped with 3 separate bubble levels. A 1m long stainless steel ruler was then used to measure the distance from the top of the ladder to the base of the habitat (but without forcing it into the soil layer) within every 10cm x 10cm square (4 x 5cm squares) of each 0.5m sub-quadrat. The level to the base and top of each dipwell was also measured.


2.2 Habitat assessment

Following the installation of the loggers, and following the micro-topographical measurements, two monitoring rounds were coordinated with the hydrogeological experts Gerry Baker and Niamh Rogan. The dates for the monitoring events were selected based on the prevailing climactic conditions. The first was a wet condition survey (9th and 12th March) and the second was a dry condition survey undertaken on 7th September 2016.

In each round the micro-habitat cells were classified, by observing the condition within each 5cm x 5cm cell. This was done by laying a plastic quadrat sub-divided into one hundred 5cm x 5cm squares in each of the four sub-quadrats within the 1m x 1m quadrat. The habitat within each 5cm square was then categorized into 5 classes:

	Inundated		Unsuitable		Unsuitable & sub-optimal		Sub-optimal		Optimal

This resulted in 400 observations in each metre square on two occasions, a total of 4,800 observations.

2.3 Snail sampling

Vertigo geyeri cannot be reliably searched for by eye in the field. To determine its presence/absence a sample of moss and sedge material (c. 2 litres volume) was collected. These samples were collected by plucking sedge and moss from sward, mounds and tussocks, or by cutting vegetation (sward and small tussocks comprising mainly grasses, low herbs and moss) at ground level using a sharp knife with a serrated blade. To avoid local destruction of the sward, material was collected by amalgamating small sub-samples from places of the most optimal habitat close to, but not within, each quadrat. The vegetative material was teased apart and spread on sheets of newspaper to dry. This was then shaken over a 5 mm sieve to remove the bulk of the plant material but to allow all molluscs to pass through. The residue was passed over a graded stack of sieves and examined microscopically. All molluscs in the samples were identified and counted. The very wet conditions of the habitat in March meant that snail sampling could be destructive so a return visit was made on 25th May 2016 to sample for snails during optimum conditions.

3.0 Results

The results are given for topography and habitat in 3.1 from PZ6 upslope to PZ1 downslope close to the lake shore. The molluscan species found are discussed together at 3.2.

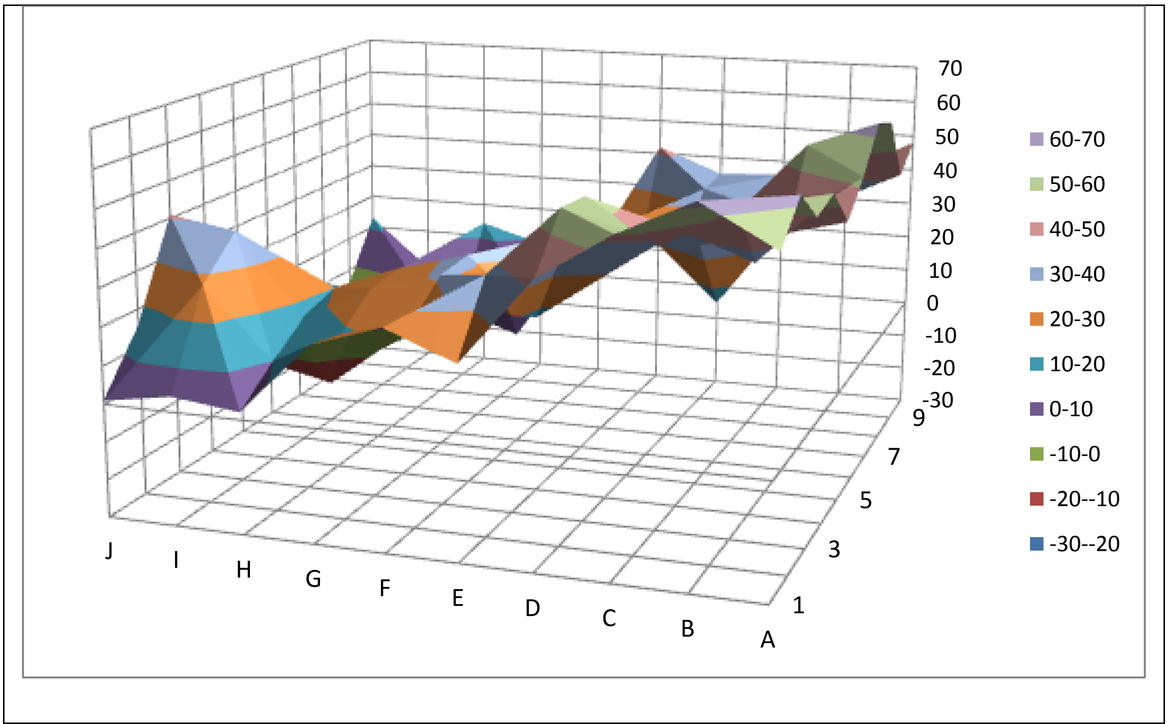
3.1 Topography and habitat results

PZ6

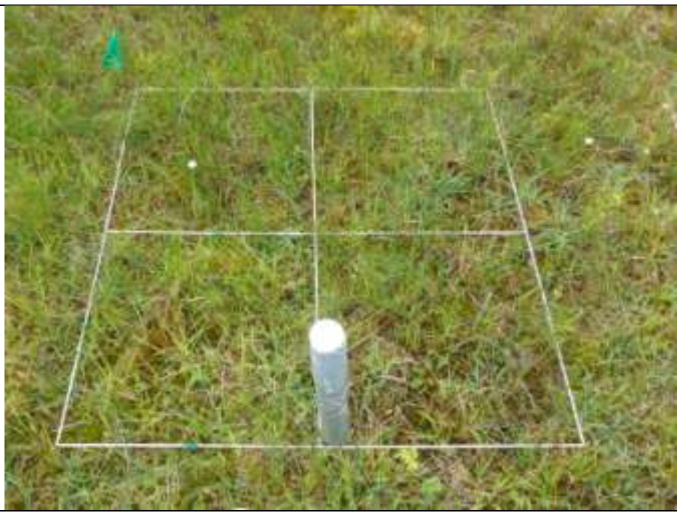
Grid reference at dipwell: G39689 15578

The habitat in this quadrat was very homogenous, on a slope. There are low growing *Drepanocladus revolvens* mounds, with sparse *Carex panicea* and *C. viridula* within a mosaic. In September *Equisetum palustre* was present throughout, with occasional *Parnassia palustris* and *Selaginella.* The study metre square was saturated but not inundated. The site was classed as Sub-optimal *V.geyeri* habitat throughout in both March and September. Figure 1 provides a topographical diagram of the surface heights within the metre square relative to the base of the dipwell as measured in the survey and set at 0.

Figure 1 Surface topography relative to base of dipwell (mm)



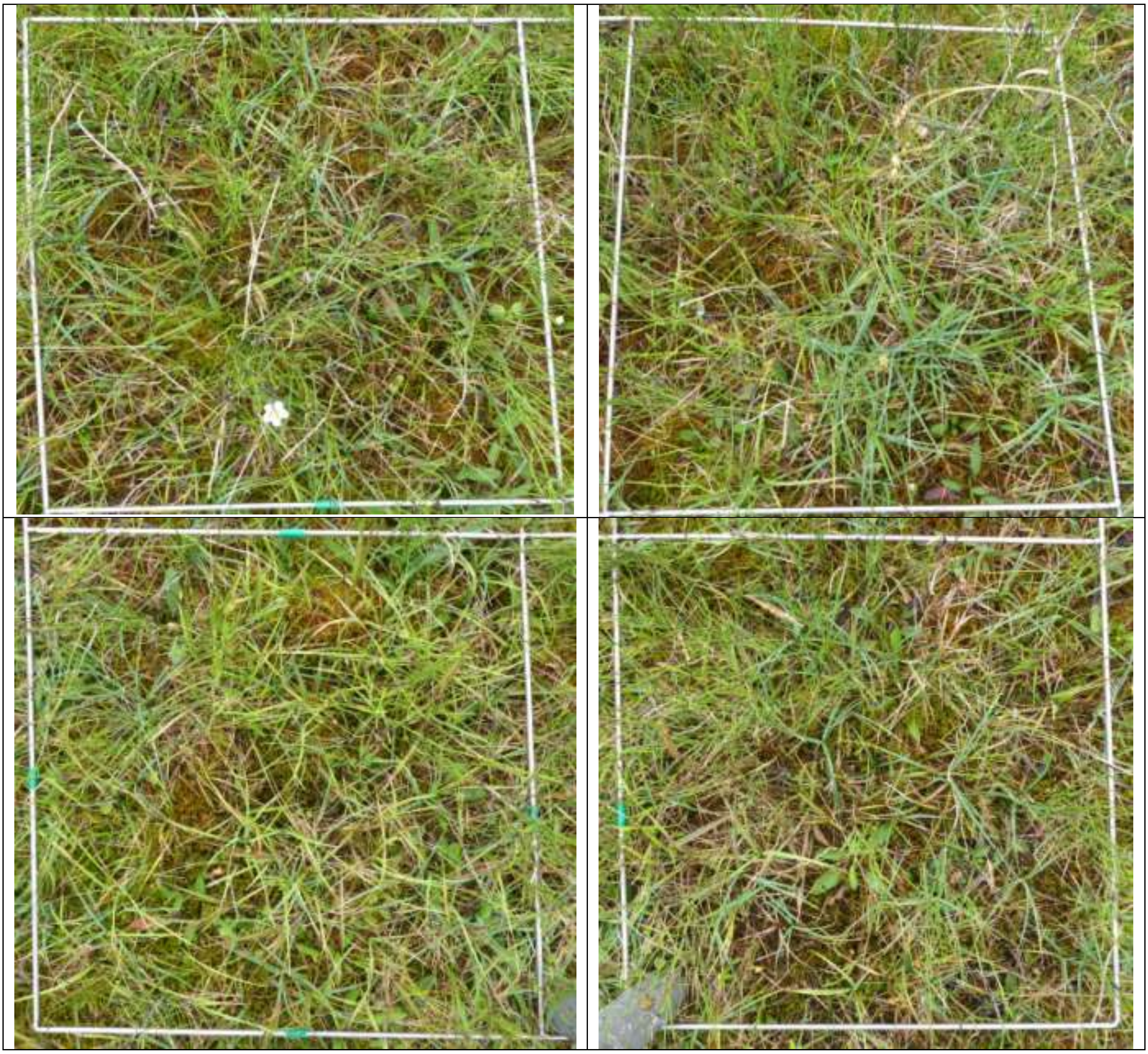
Photographs of PZ6 quadrat

	
Quadrat in March	**Quadrat in September**
	

Relative location of quadrat

Photographs of habitat in quadrat March 2016

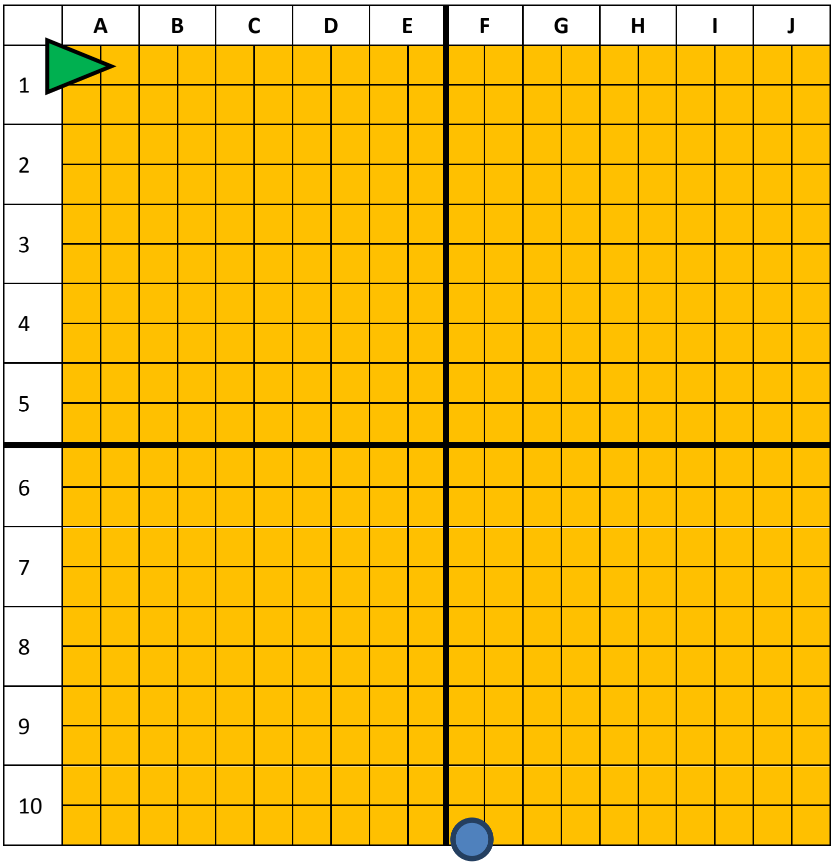
Photographs of habitat in quadrat September 2016



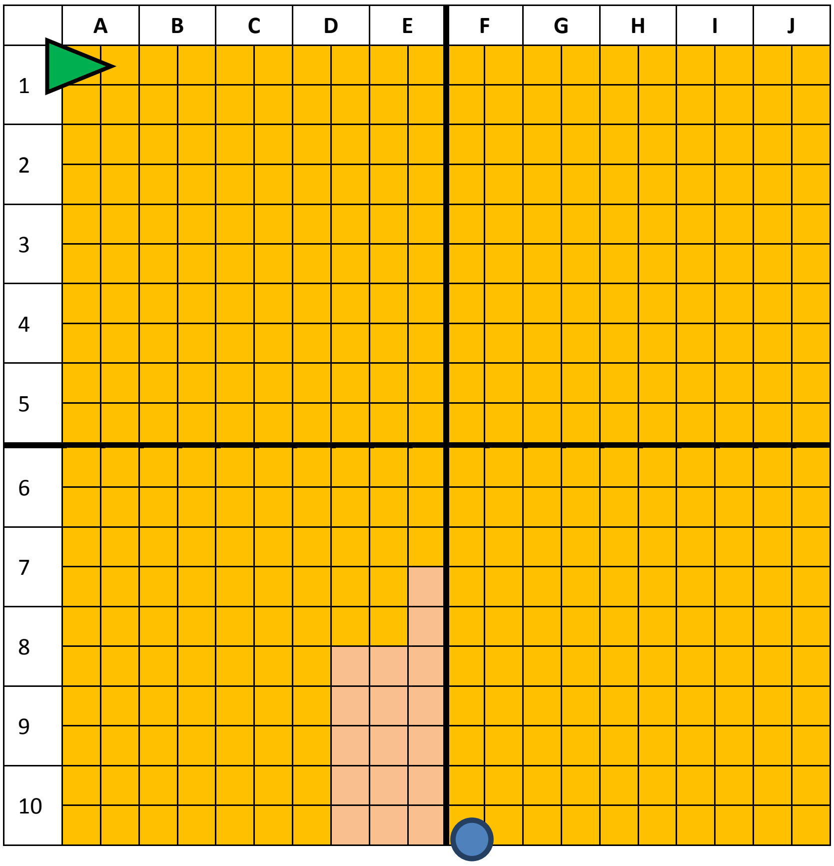
Habitat classification

Key		Inundated		Unsuitable		Unsuitable & sub-optimal		Sub-optimal		Optimal	Dipwell	Flag

March 2016



September 2016



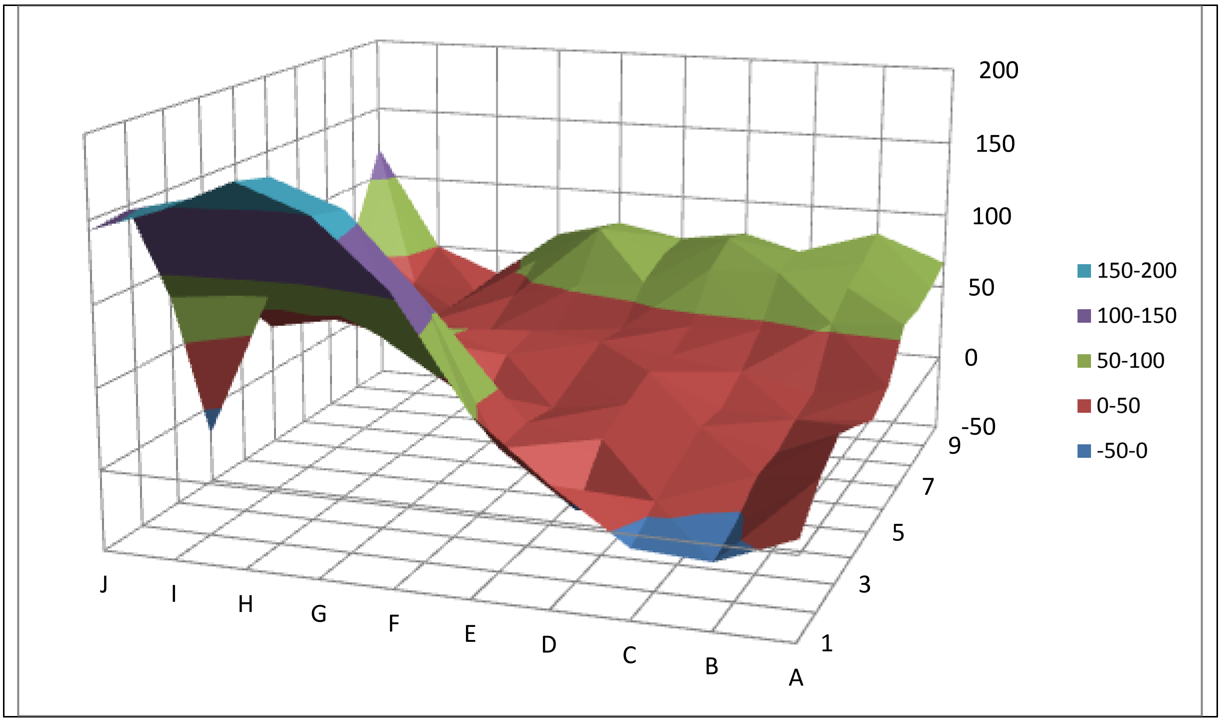
PZ5

Grid reference at dipwell: G39688 15557

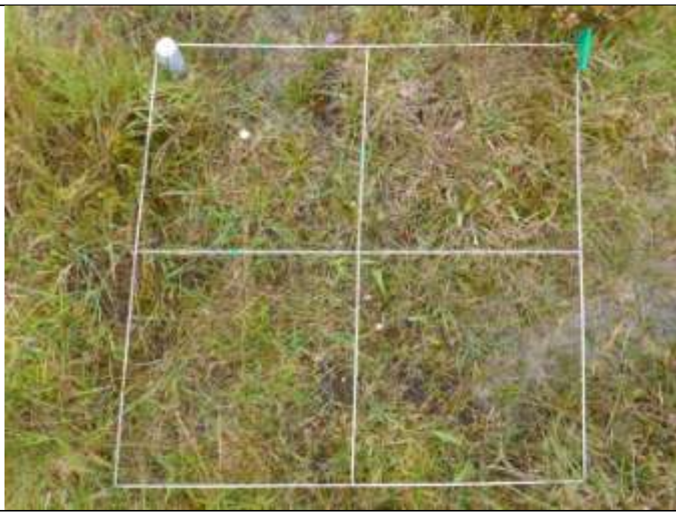
This quadrat consisted of undulating ground with two runnels with standing water at both times of year.

The habitat was a low growing mosaic of *Drepanocladus* and *Campylium stellatum* moss mounds, with sparse *Carex panicea* and *C. viridula,* and in September *Equisetum palustre* was present. Other mosses, grasses and heather were present on the higher mounds. The quadrat was classed as mostly Sub-optimal or Sub-optimal/unsuitable mix *V.geyeri* habitat throughout in both March and September. Habitat classed as Optimal in March was re-classed as Sub-optimal in September.

Surface topography relative to base of dipwell



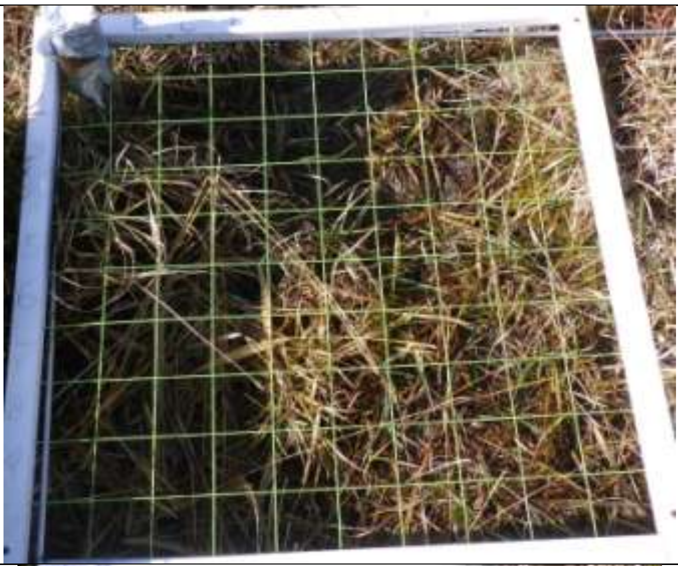
Photographs of quadrat

Quadrat in March	Quadrat in September


Relative location of quadrat

Photographs of habitat in quadrat March 2016

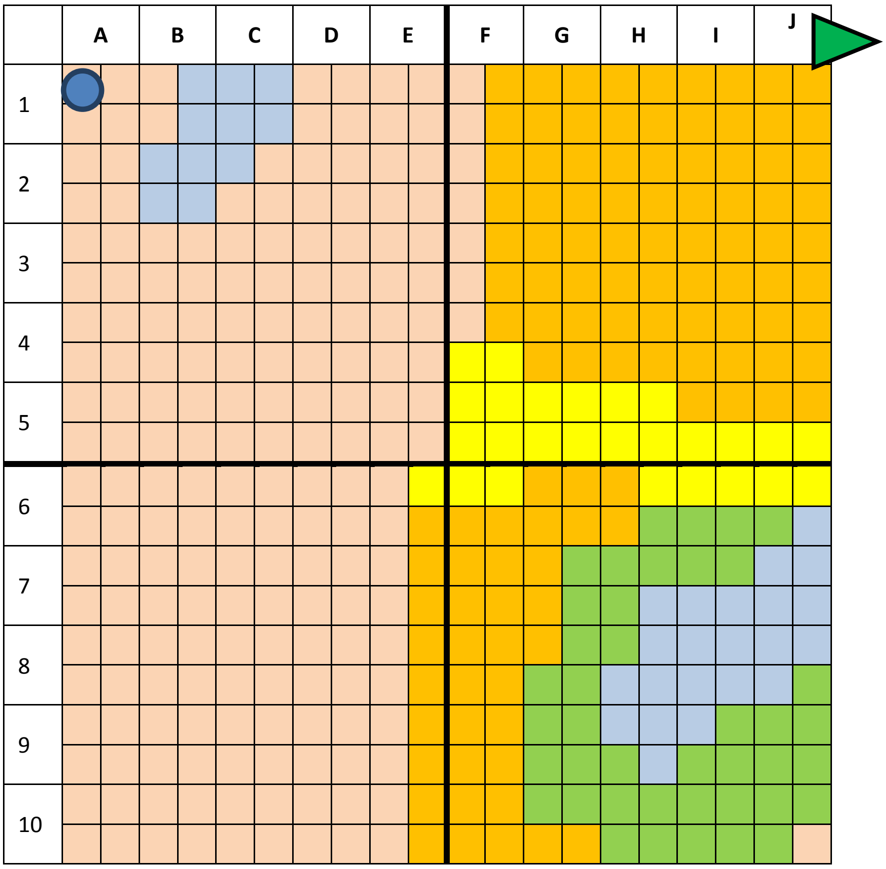



Photographs of habitat in quadrat September 2016

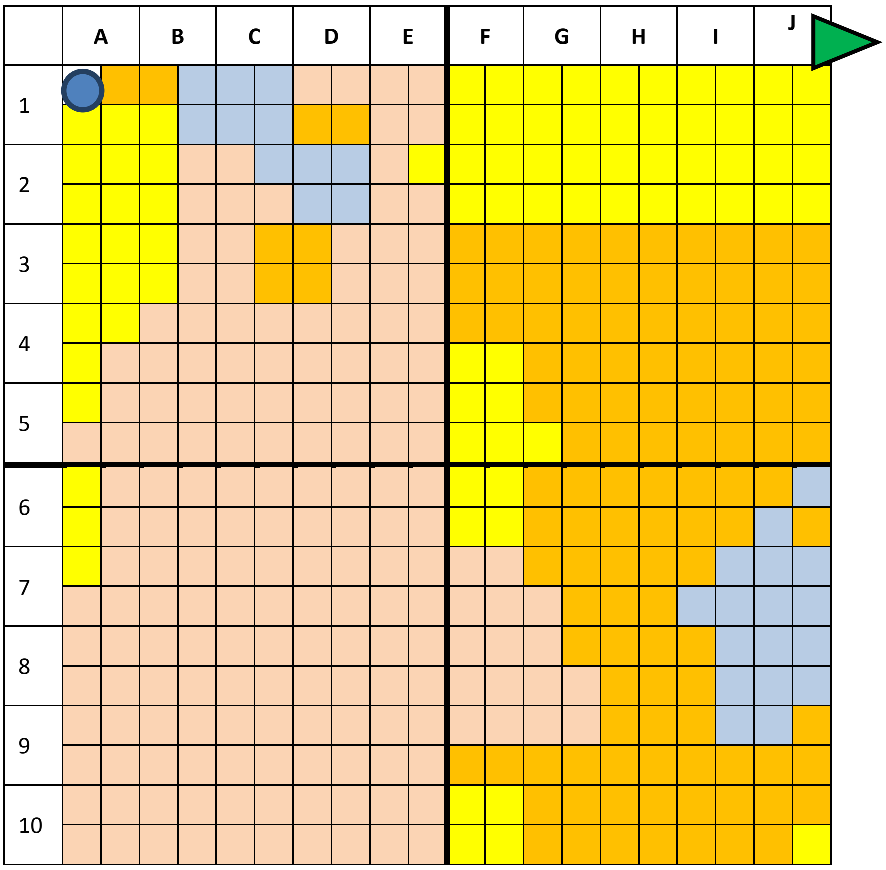
Habitat classification

Key		Inundated		Unsuitable		Unsuitable & sub-optimal		Sub-optimal		Optimal	Dipwell	Flag

March 2016



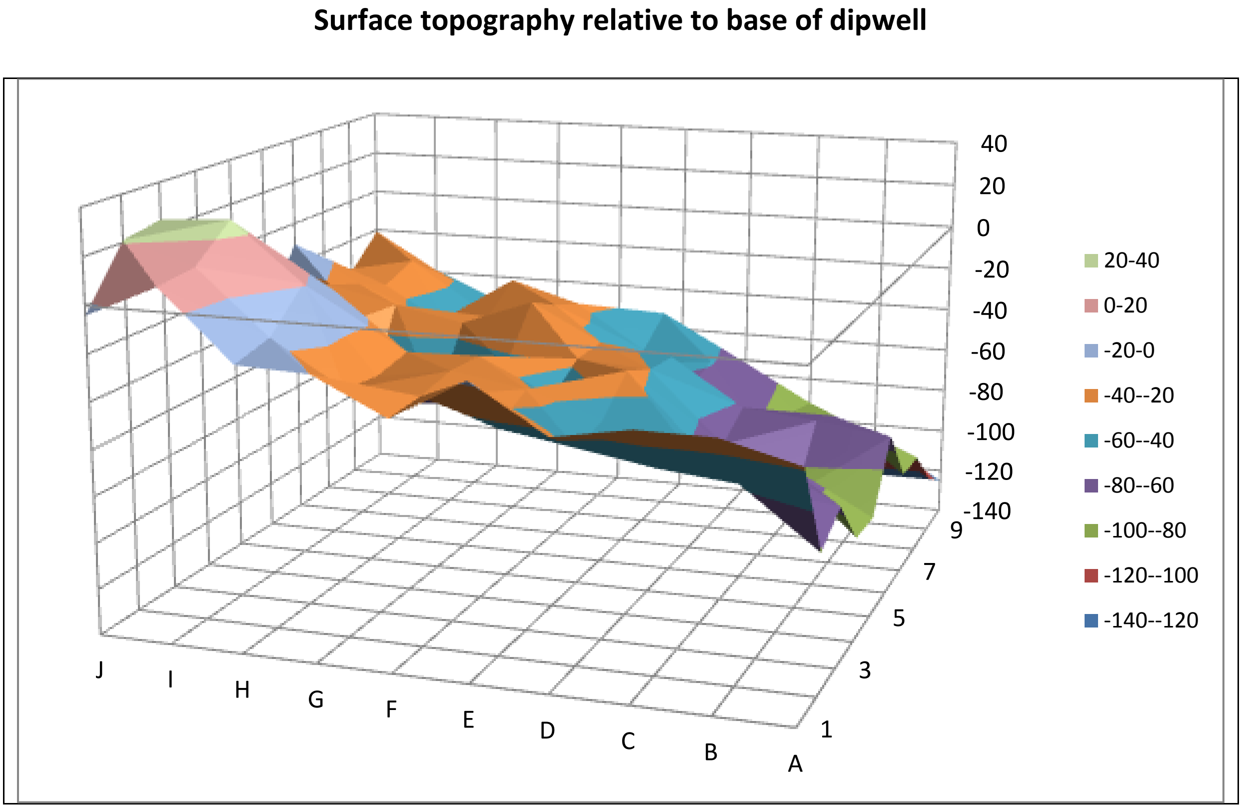
September 2016



PZ4

Grid reference at dipwell: G39700 15531

The habitat in this quadrat was a low, saturated mossy sward with extensive cover of *Campylium stellatum* moss and *Equisetum palustre*. Sparse *Carex viridula, Parnassia palustris* and *Briza media* was visible in September. The quadrat was saturated but not inundated, but there is a pool of open water nearby. It was classed as mostly Optimal and Sub-optimal *V.geyeri* habitat throughout in both March and September.

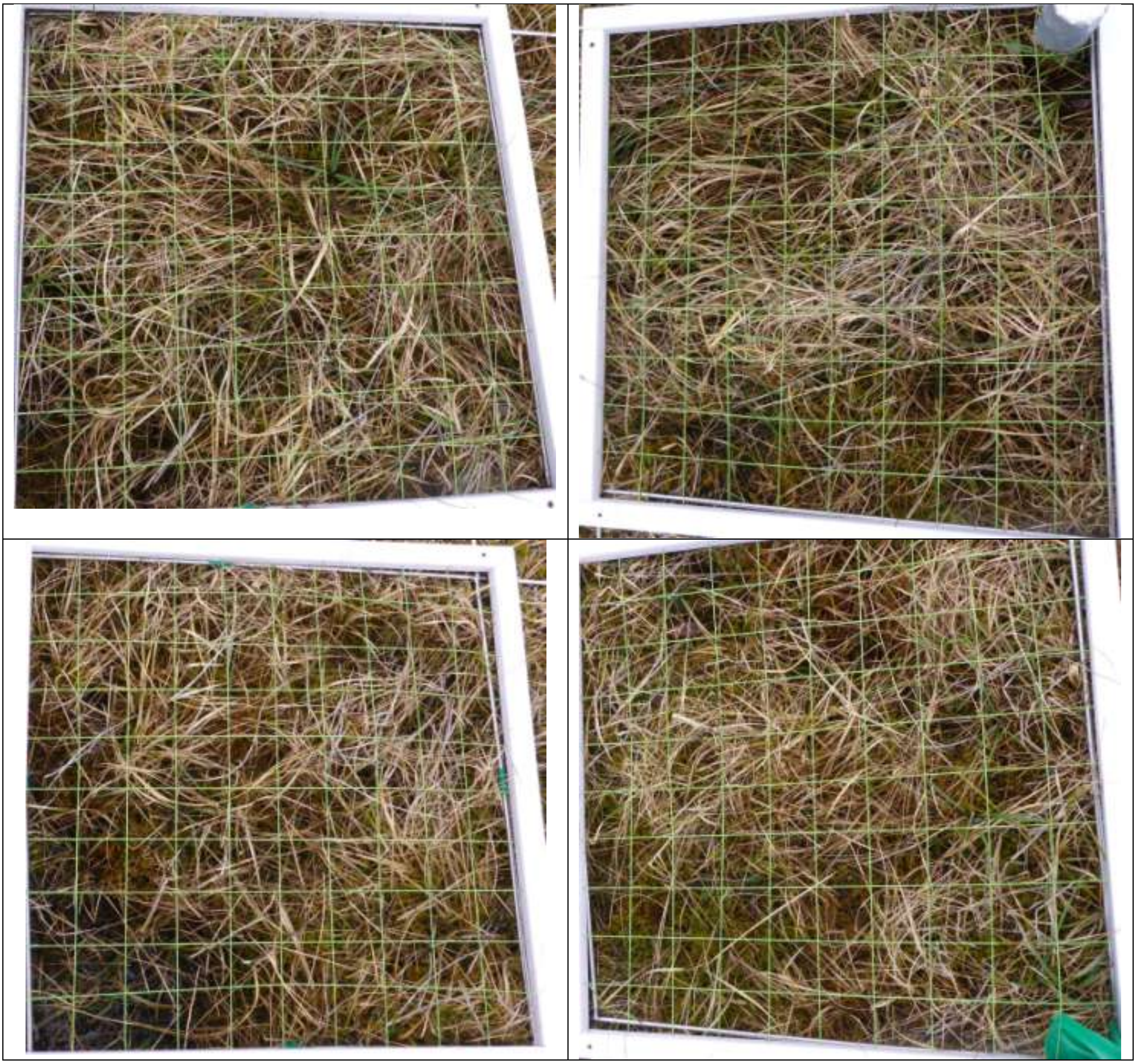


Photographs of quadrat

	
Quadrat in March	**Quadrat in September**

Relative location of quadrat

Photographs of habitat in quadrat March 2016

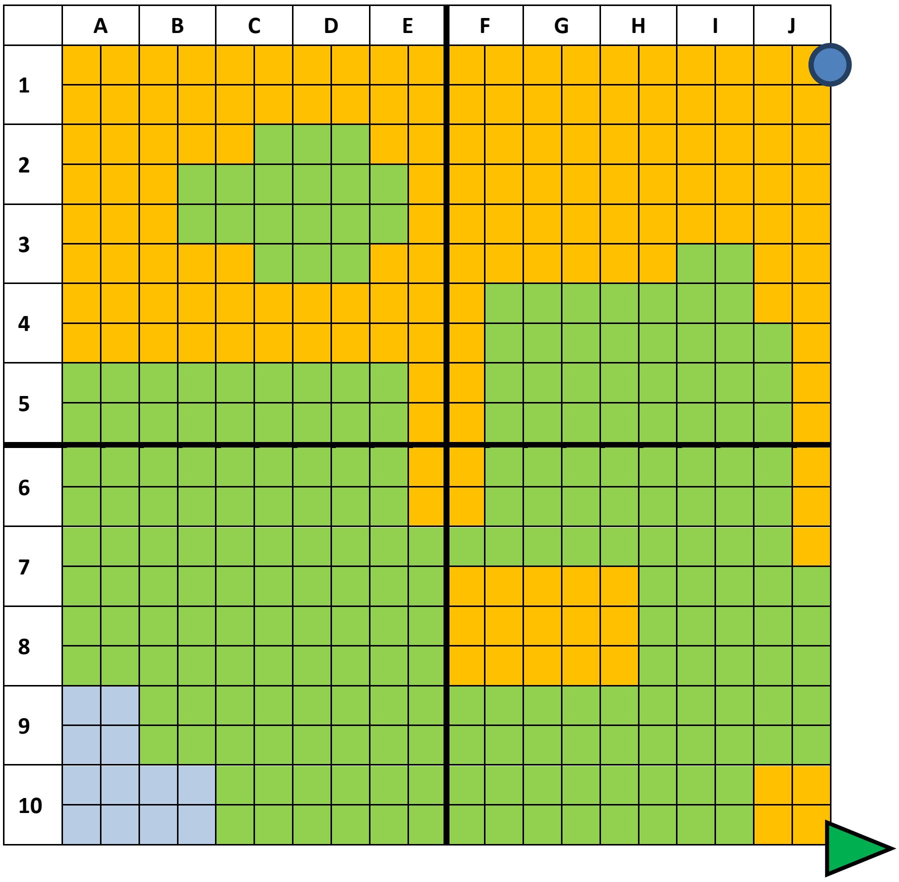


Photographs of habitat in quadrat September 2016

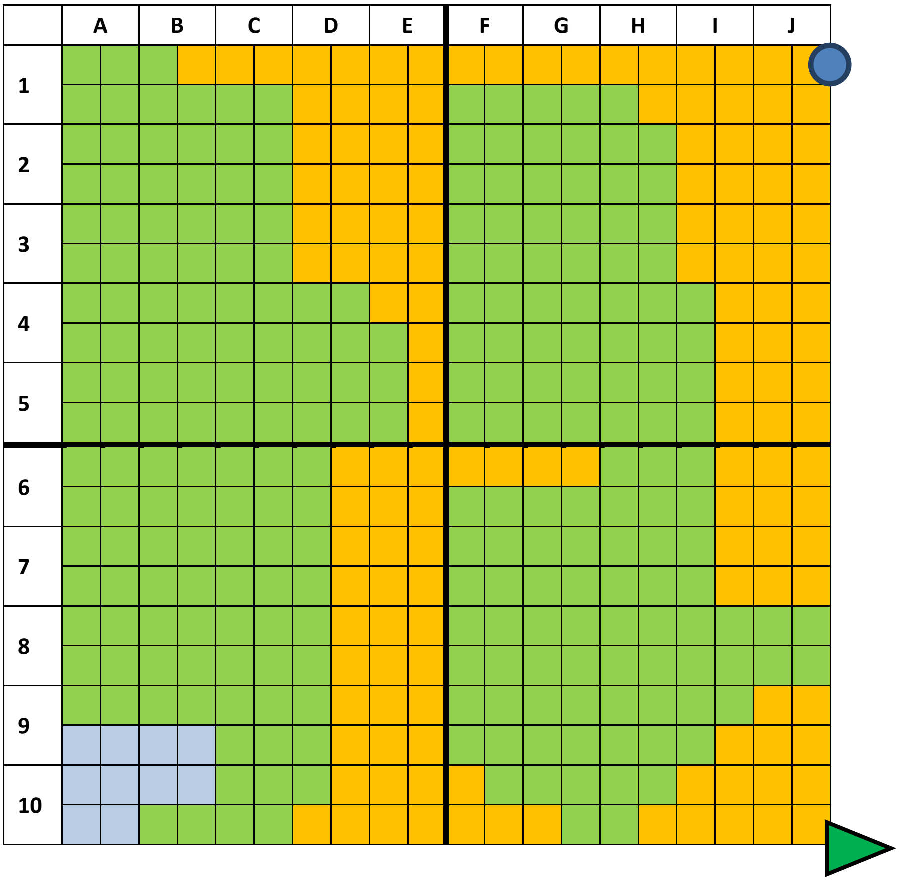
Habitat classification

Key		Inundated		Unsuitable		Unsuitable & sub-optimal		Sub-optimal		Optimal	Dipwell	Flag

March 2016



September 2016

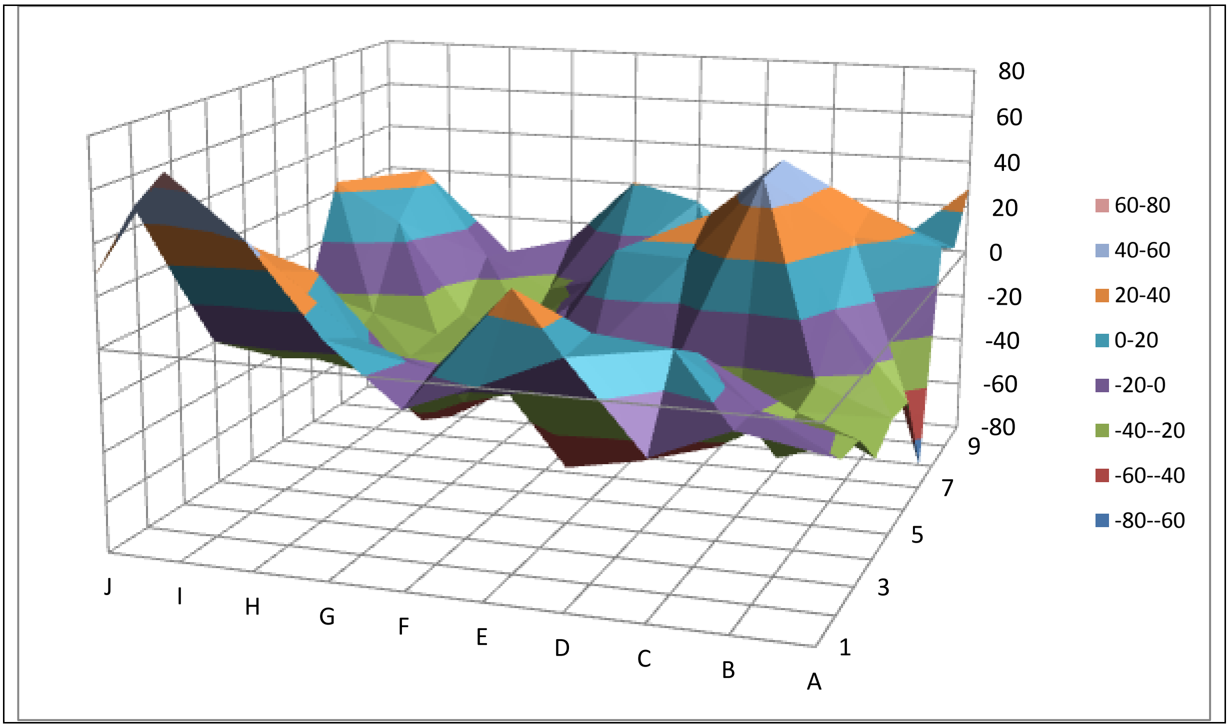


PZ3

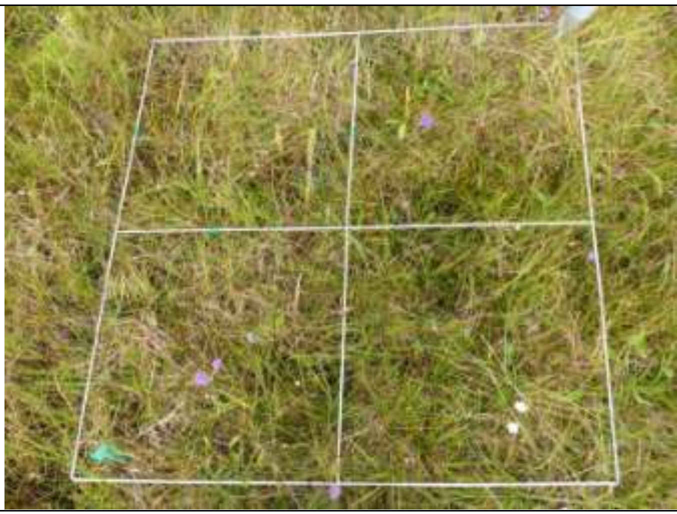
Grid reference at dipwell: G39691 15533

This quadrat had a species-rich and relatively homogenous botanical composition. It consisted mainly of wet sward with mosses (*Drepanocladus revolvens* and *Campylium stellatum*), with a range of sedges including *Carex viridula* and *C. dioica.* In September the remains of orchids (*Gymnadenia conopsea*) and flowering scabious (*Succisa pratensis*) and sparse *Parnassia palustris* were present. The quadrat was classed as mostly Sub-optimal with some Optimal *V.geyeri* habitat throughout in both March and September.

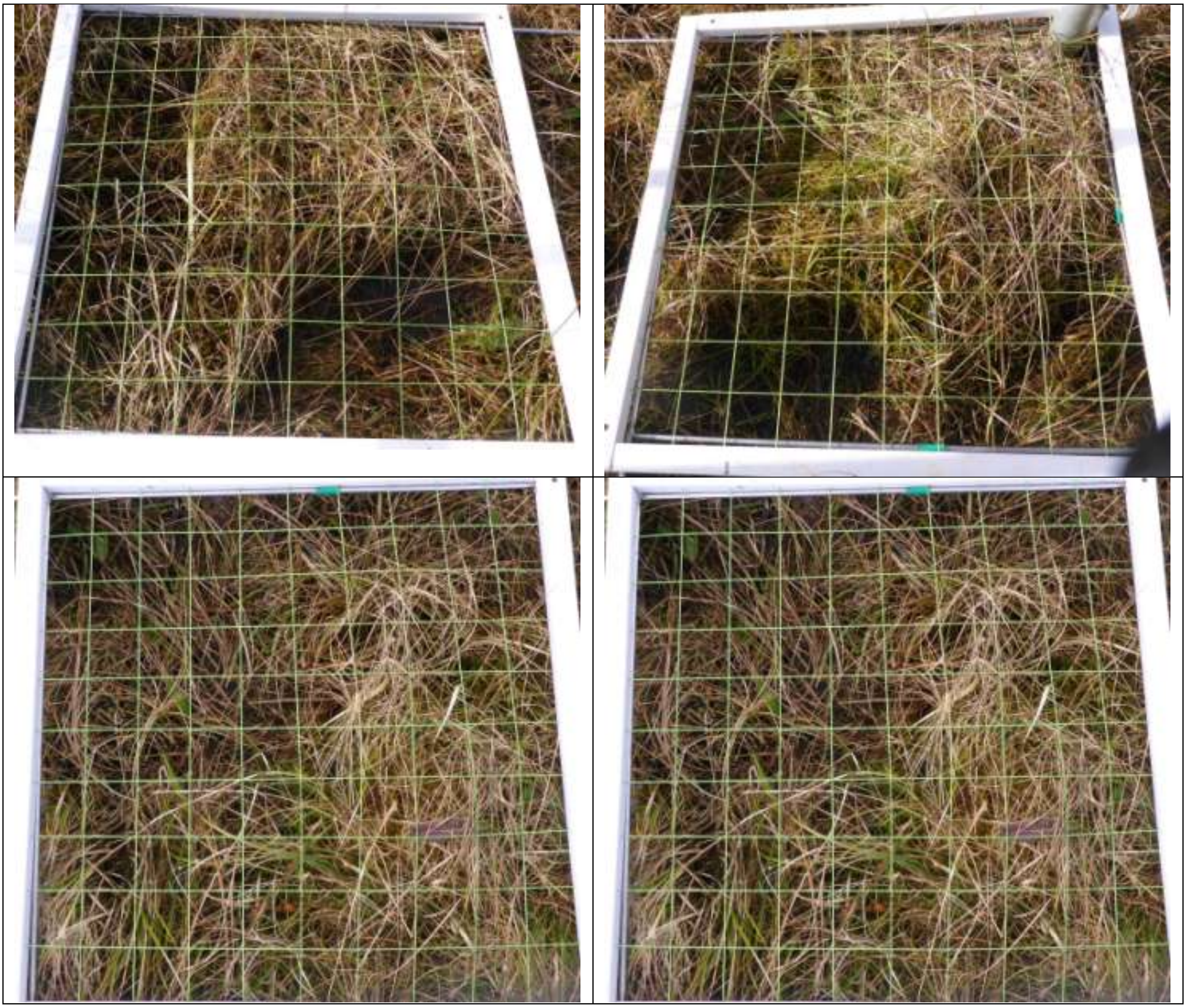
Surface topography relative to base of dipwell



Photographs of quadrat

	
Quadrat in March	**Quadrat in September**
	
Relative location of quadrat	

Photographs of habitat in quadrat March 2016



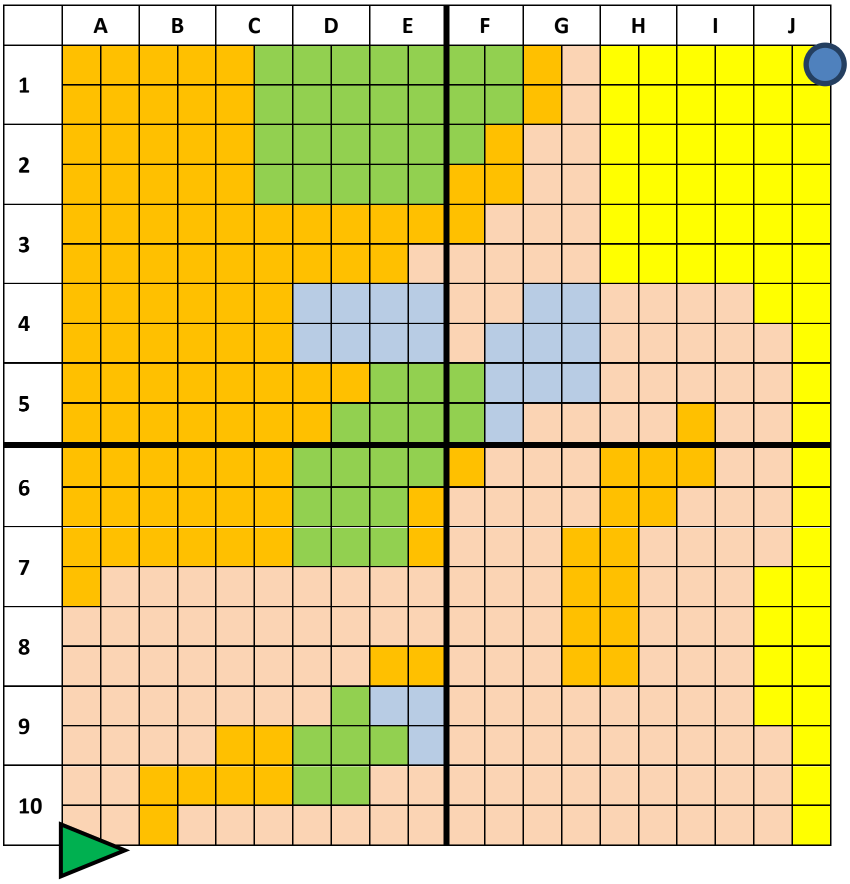
Photographs of habitat in quadrat September 2016

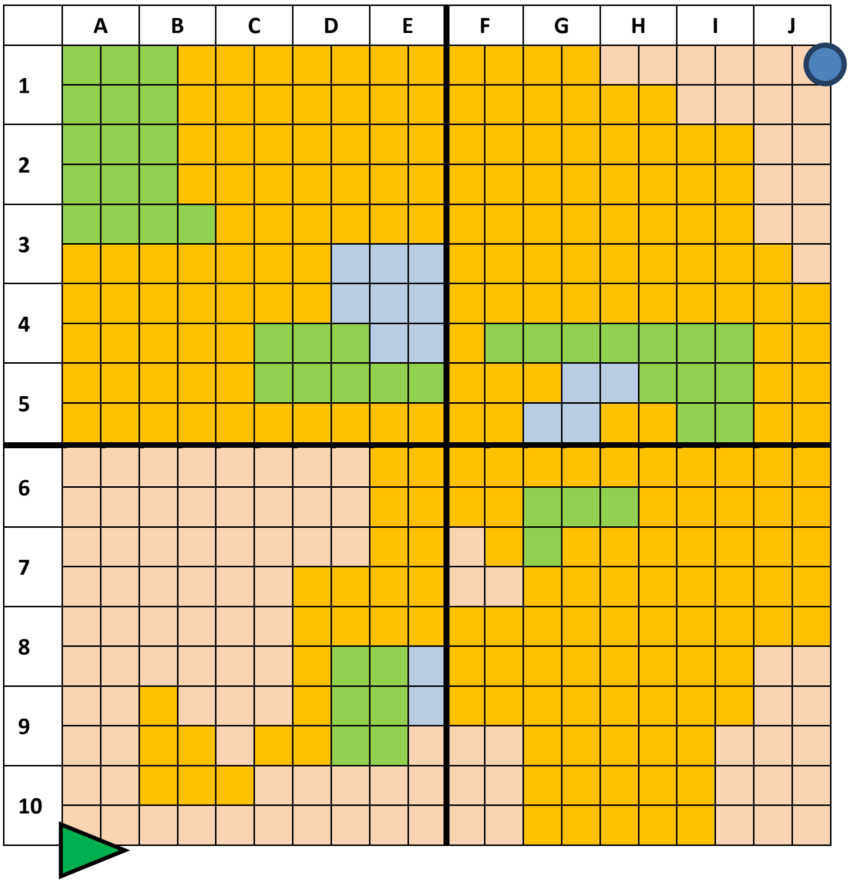
Habitat classification

Key		Inundated		Unsuitable		Unsuitable & sub-optimal		Sub-optimal		Optimal	Dipwell	Flag

March 2016



September 2016

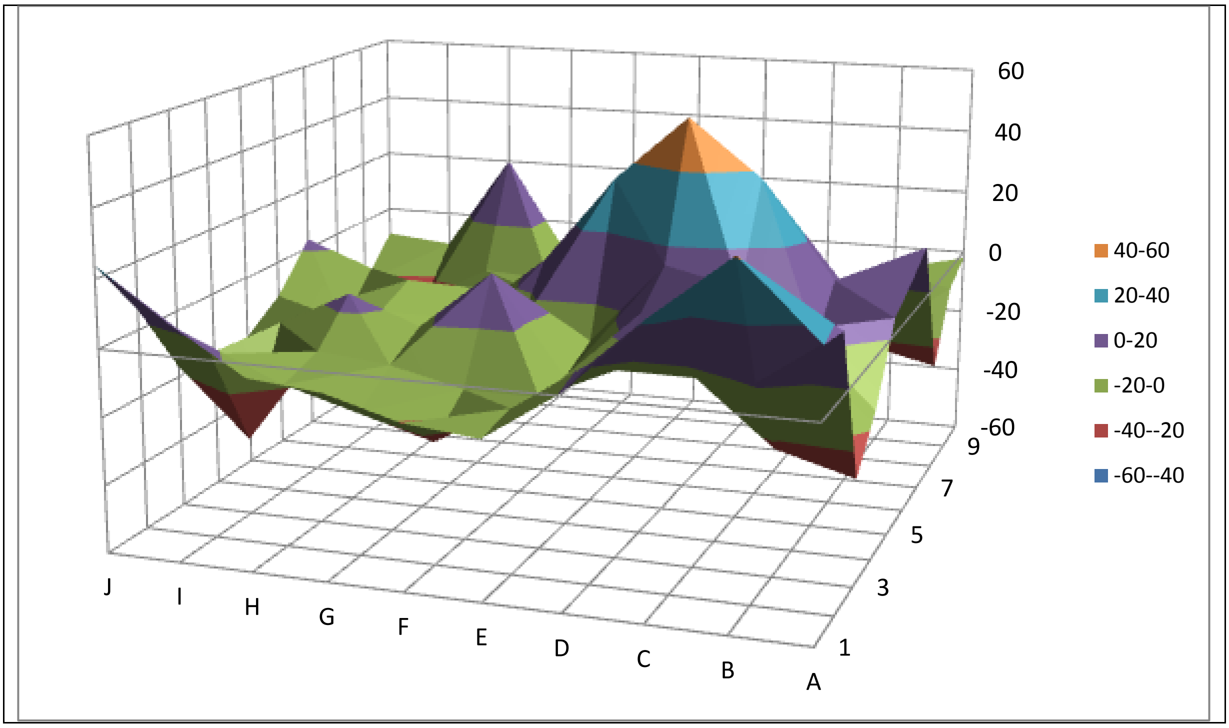


PZ2

Grid reference at dipwell: G39695 15523

The habitat in this quadrat was very wet, saturated fen meadow with *Drepanocladus revolvens, Campylium stellatum*, and *Carex viridula* throughout. In September *Menyanthes trifoliata, Equisetum palustre* and *Succisa pratensis* were present. It was classed as Optimal and Sub-optimal *V.geyeri* habitat throughout in both March and September.

Surface topography relative to base of dipwell



Photographs of quadrat

Quadrat in March	Quadrat in September

Relative location of quadrat

Photographs of habitat in quadrat March 2016

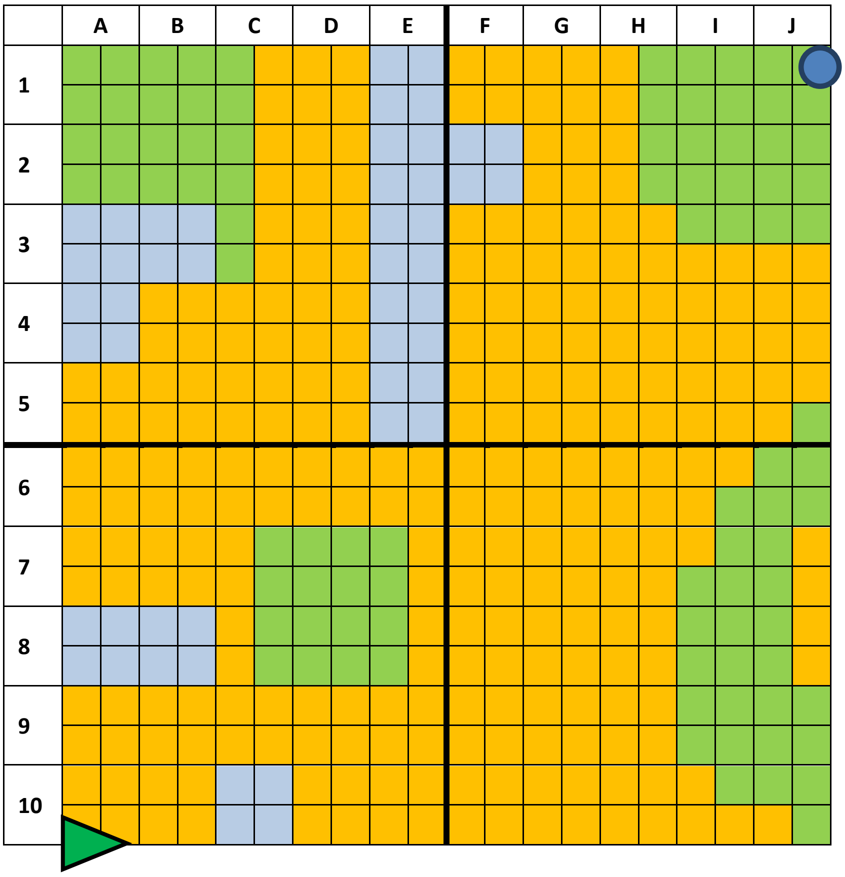



Photographs of habitat in quadrat September 2016

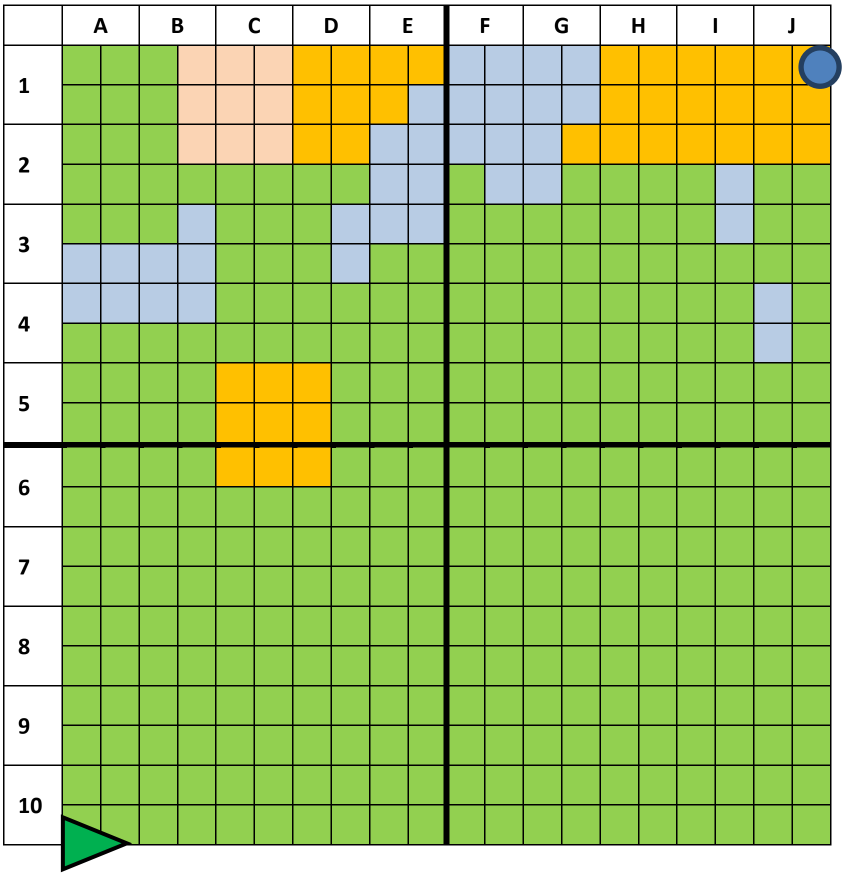
Habitat classification

Key		Inundated		Unsuitable		Unsuitable & sub-optimal		Sub-optimal		Optimal	Dipwell	Flag

March 2016



September 2016

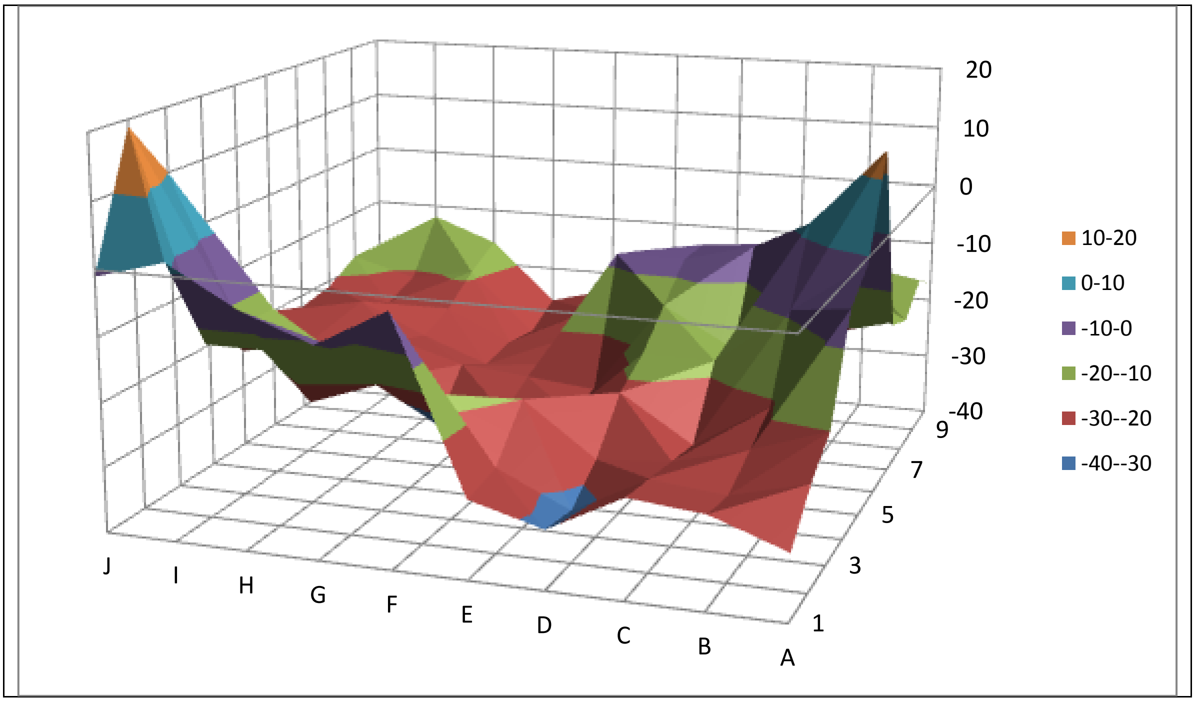


PZ1

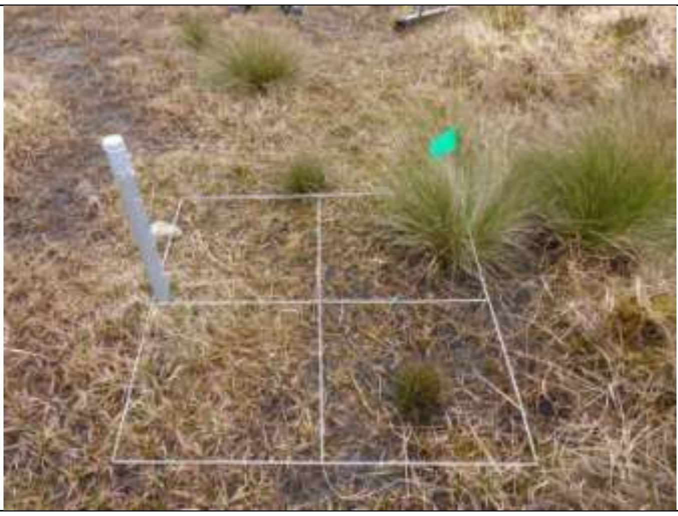
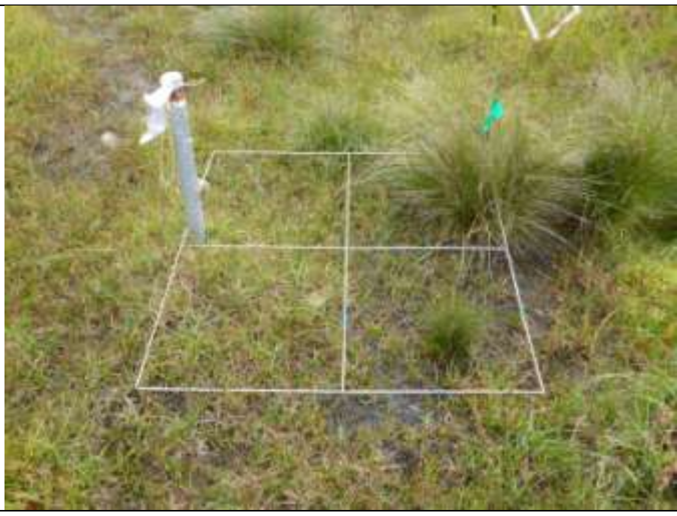
Grid reference at dipwell: G39691 15516

This quadrat consisted of generally flat ground with bare muddy patches. It featured two *Schoenus nigricans* tussocks with sparse surrounding moss. There was also sparse *Carex panicea* and *C. viridula* with butterwort (*Pinguicula vulgaris*), bog asphodel (*Narthecium ossifragum*), and bell heather (*Erica cinerea*). It was classed as mostly unsuitable *V.geyeri* habitat throughout in both March and September.

Surface topography relative to base of dipwell

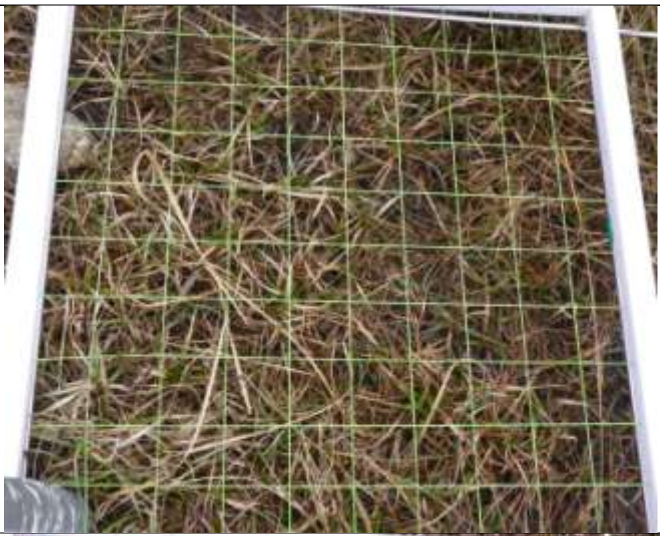


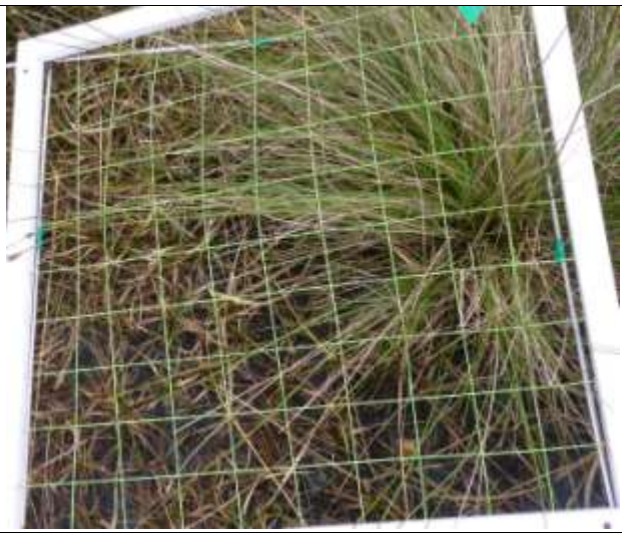
Photographs of quadrat

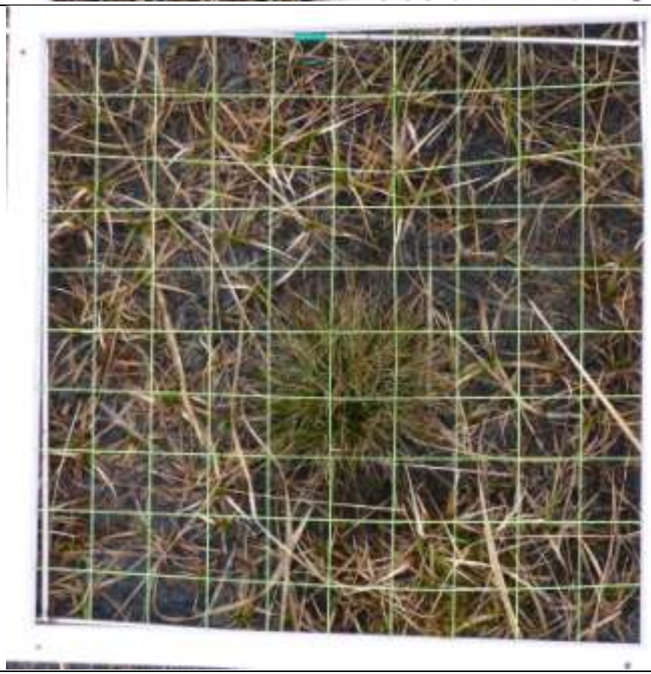
	
Quadrat in March	**Quadrat in September**
	

Relative location of quadrat

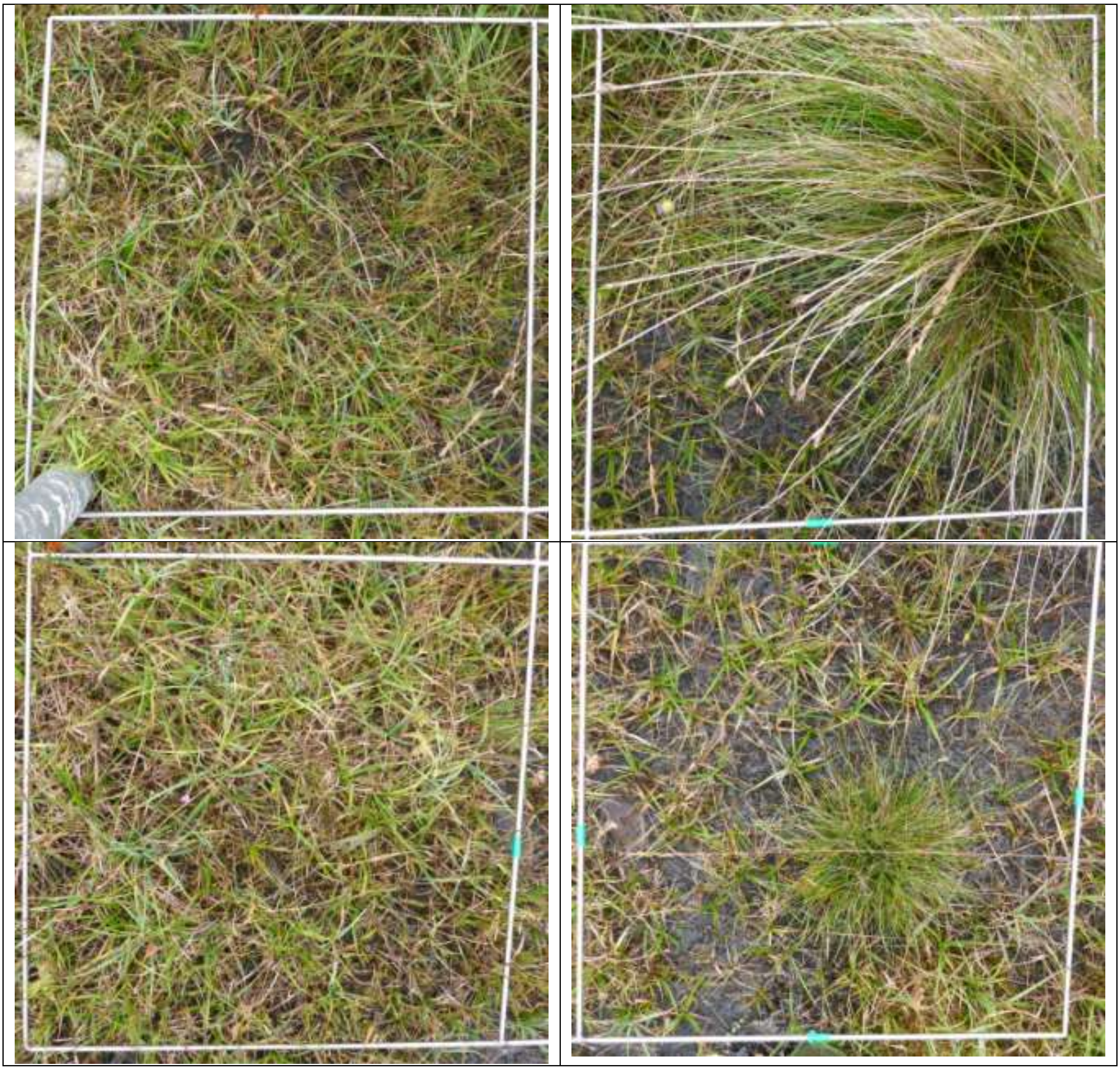
Photographs of habitat in quadrat in March 2016







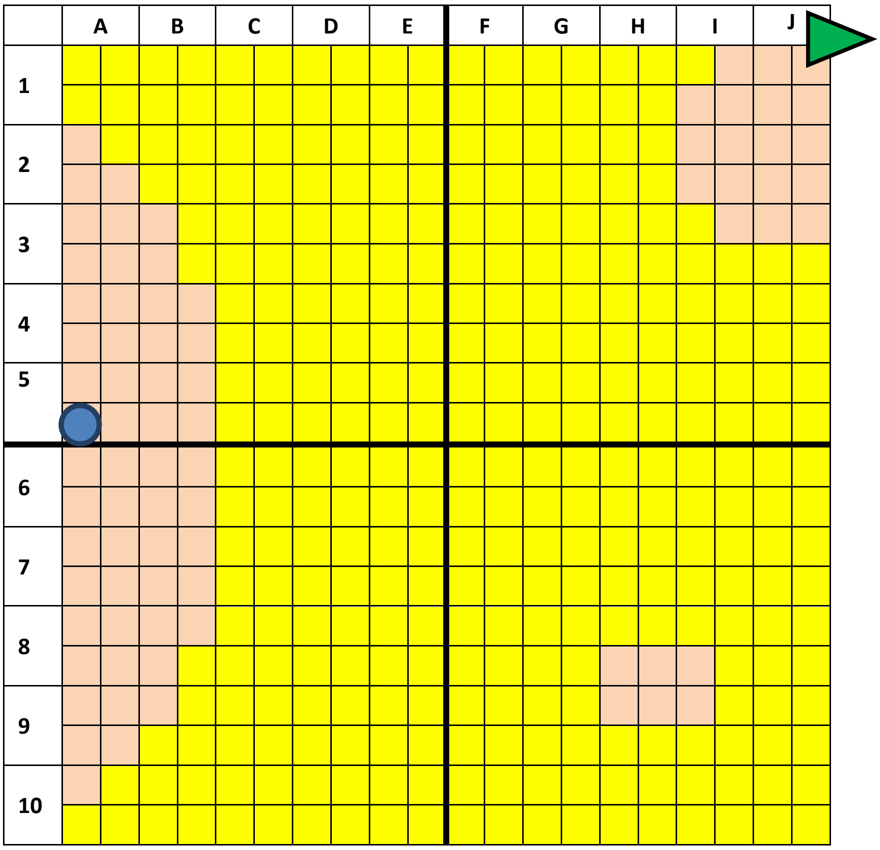
Photographs of habitat in quadrat in September 2016



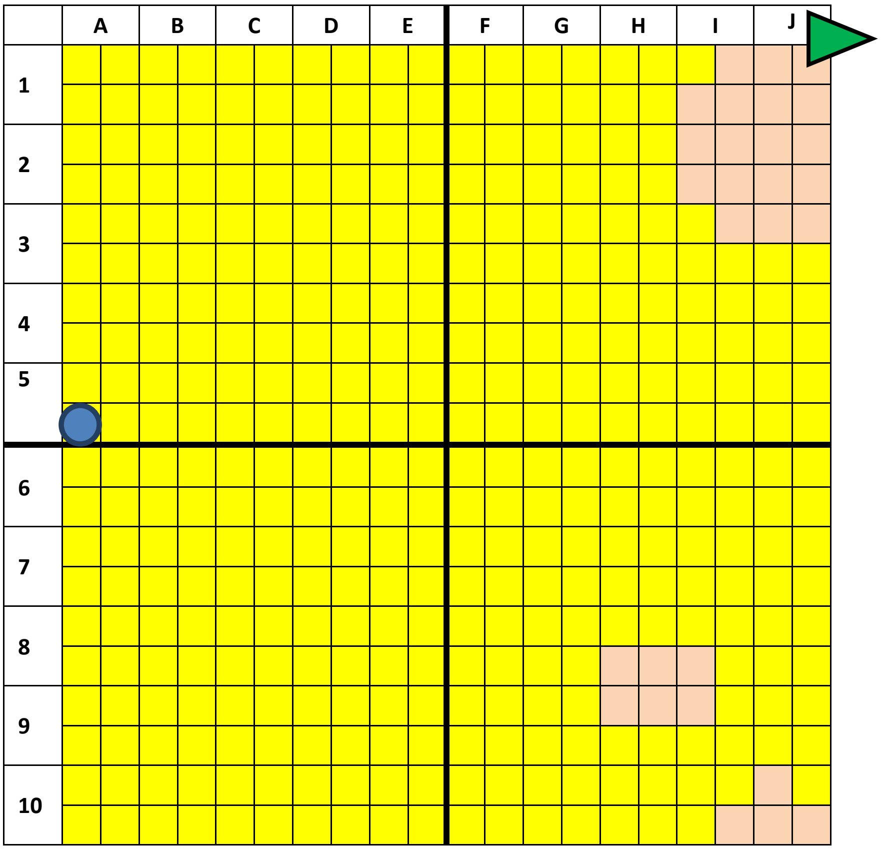
Habitat classification

Key		Inundated		Unsuitable		Unsuitable & sub-optimal		Sub-optimal		Optimal	Dipwell	Flag

March 2016



September 2016



3.2 Results of snail sampling

A total of 5 molluscan species were found in the environs of the 6 quadrats, and of these only two species were found alive. Snail shells can persist so shells found with no live animals could be dead for some time. The live snails (*Galba truncatula, Pisidium personatum)* are both species that have a wide wetness tolerance.

Table 3.1. Molluscan species found in the 6 quadrats in the *Vertigo geyeri* habitat area study of Lough Talt, 2016. Species nomenclature follows Anderson (2005) (L = live, D = dead)

Quadrat	PZ6	PZ5	PZ4	PZ3	PZ2	PZ1
Galba truncatula	-	-	1L	2D	-	1D
Nesovitrea hammonis	-	-	-	1D	-	-
Oxyloma elegans	-	-	2D	1D	1D	-
Pisidium personatum	-	-	3L	-	5L	-
Potamopyrgus antipodarum	-	-	4D	-	7D	-

Table 3.1 shows the results of the 2016 survey. Table 3.2 places these results in context with other results since 1997. *Vertigo geyeri* was lost early, followed by the more sensitive of the fen indicator species, leaving only the most tolerant species present since 2008.

Table 3.2. Combined Molluscan species found in *Vertigo geyeri* habitat area of Lough Talt, from Moorkens (1997, 2006, 2007, 2011, 2012). Species nomenclature follows Anderson (2005).

Species	**1997**	**2005**	**2007**	**2008**	**2010**	**2012**	**2016**
Potamopyrgus antipodarum	X					X	X
Armiger crista	X						
Galba truncatula	X	X	X	X	X	X	X
Stagnicola fusca	X						
Cochlicopa lubrica	X	X	X	X			
Carychium minimum	X	X	X	X		X	
Carychium tridentatum	X						
Oxyloma elegans	X	X	X		X	X	X
Vertigo geyeri	X	X	X				
Vertigo antivertigo	X	X	X	X			
Vertigo substriata			X				
Vertigo pygmaea				X			
Columella aspera	X	X	X	X			
Vallonia pulchella	X						
Vitrea crystellina	X						
Leiostyla anglica		X	X	X			
Punctum pygmaeum		X	X	X		X	
Discus rotundatus		X					
Vitrea crystellina	X	X	X	X			
Nesovitrea hammonis	X	X	X	X		X	X
Zonitoides nitidus	X						
Oxychilus alliarius		X					
Euconulus fulvus	X					X	
Euconulus alderi	X	X	X	X			
Trochulus hispidus	X						
Trochulus striolatus	X						
Pisidium personatum	X		X	X	X	X	X
Total No. Species	**21**	**14**	**14**	**12**	**3**	**8**	**5**

4.0 Discussion

This is a preliminary report of results, after which it was proposed to examine the data in a workshop meeting with the expert hydrologists in order to interpret the reports from the two disciplines. This will assist in defining a conceptual model of the pattern and level of abstraction that may be safe and levels that could potentially impact on the required artesian conditions for the *V. geyeri* population.

A final outcome from this study should be a multi-disciplinary report which would include the survey results and the conclusions as demonstrated from the hydrological evidence.

The preliminary conclusions that can be drawn are as follows:

The range of micro-topography and the proximity of saturated pockets to inundated hollows follow the patterns observed during the Pollardstown Fen studies and fit with the requirements for sustainable habitat for this sensitive snail species with regard to groundwater levels as published by Kuczynska & Moorkens (2010).

The juxtaposition of open water and saturated optimal habitat confirms the patterns for other *V. geyeri* sites that create a combination of saturated ground and micro-hydrological parameters, particularly very small scale pockets of high humidity. The best areas of habitat that were noted in March were also the best areas in September. Although these two dates were chosen to represent the wettest phase of the year (March) followed by the lowest recession period (September), there was no significant loss of wetness at the surface, where 5% of the 2,400 cells were inundated in March, 4% were still inundated in September. In March 16% of the cells were classified as saturated optimal habitat and although surveyed at the lowest point in the recession of groundwater, in September optimal habitat classification had increased to 26% of the six quadrats.

These results suggest that the habitat appears to be ideal for *Vertigo geyeri* and related fen spring-seepage specialist species, with the exception of the uppermost (PZ6) and the lowermost (PZ1) quadrats. At higher ground there appears to be too great a loss of connection with the groundwater to be ideal, and at low ground the rocky flatter ground results in poor resilience of habitat for specialist species that demand an even supply of water and humidity.

Therefore, the ideal habitat is restricted to a narrow band of habitat that enjoys a constant and even supply of phreatic pressure and groundwater seepage.

Over the last 8 years a number of possible causes of loss of *Vertigo geyeri* and its fen allied species were proposed as possibilities – including external drainage, changes in weather patterns, excessive flooding or excessive drought. From conditions on the ground over the years, flooding seemed more likely than drought. However, the habitat currently looks ideal and demonstrates all the requirements of high quality fen seepage-meadow conditions, thus external drainage and rainfall patterns are unlikely to be the cause. Severe once-off flooding is also unlikely to be the cause as there are plenty of pockets of higher ground that could have acted as Refugia to the less sensitive species. The lack of recovery of the fen specialist species suggests that they were extirpated from quite a wide area, suggesting the cause was more likely to have been a severe low water deficit, resulting in a dearth of refugia for the wet terrestrial specialists. During droughts, wet terrestrial species take refuge in pockets of habitat that are normally inundated but become barely saturated in droughts. In order to extirpate a range of species for 8 years, it is likely that the wet zone refuge areas became too dry to support the more sensitive species. Tolerance to drying is low in these species, and thus loss can occur in a few days. In contrast, even though *Pisidium personatum* and *Galba truncatula* generally live in wetter conditions than *V. geyeri*, they are adapted to withstanding drying out for a much longer period of time as they are much less sensitive species.

Analysis of the habitat quality survey compared with the moad levels from the microtopography survey was made by considering the topography levels at which optimum habitat was consistent between the March and September surveys.

The cells (10 x 10cm) where optimum habitat was found can be summarised in Table 4.1.

The optimum cells and the surrounding cells have a low level of topographical change, leaving small hummocks and hollows for capacity to allow water to pool (Table 4.2).

Table 4.1 Optimum habitat cells in the 6 quadrats

Quadrat	Number of optimum habitat cells, March	Number of optimum habitat cells, September	Number of optimum habitat cells overlapping
PZ1	0	0	0
PZ2	14	69	8
PZ3	7	4	0
PZ4	48	50	25
PZ5	4	0	0
PZ6	0	0	0
Total	66	123	33

Table 4.2 Mean and range of topography in PZ2 and PZ4

Location	N	Mean topographical level (moad)	Range
PZ2	8	136.051	66mm
PZ4	25	136.183	87mm
All cells PZ2	100	136.050	97mm
All cells PZ4	100	136.202	151mm

The water levels measured from March to September 2016 for PZ2 and PZ4 (moad) are summarised in Table 4.3 as follows:

Table 4.3 Mean and range of water levels between two study periods in PZ2 and PZ4

Quadrat	PZ2	PZ4
Water level mean	135.98	136.19
Water level min	135.26	135.95
Water level max	136.05	136.27
Range	0.79m	0.32m

Water level criteria should consider that the optimum levels observed were only found in PZ2 and PZ4 and thus the former quality and range of habitat is currently not as good as the targets set for the qualifying interest.

Water level criteria should take into consideration areas that are currently sub-optimal in quality and look at the deviation in artesian conditions between these and the currently optimal habitat as a means of restoring favourable conservation status.

Water level criteria should take into consideration that small errors in design could have significant effects on the habitat areas that rely on topographical requirements in millimetres.

In order to consider habitat that is currently sub-optimal but should be improved to optimal, without incurring the error of expecting too wide an area to become optimal, we should consider PZ3 from cells A to E in rows 1 to 5, and PZ5 from cells F to J in cells 1 to 10 (Table 4.4).

Table 4.4 Mean and range of ground levels and water levels in sub-optimal habitat in PZ3 and PZ5 during study period

Quadrat	PZ3	PZ5
N	25	50
Habitat level mean	136.125	136.747
Habitat level min	136.085	136.659
Habitat level max	136.171	136.856
Range	0.086m	0.109m
Water level mean	135.969	136.58
Water level min	135.969	136.18
Water level max	136.228	136.67
Range	0.259	0.49

Comparing the 4 quadrats, there is very little difference in gross means and ranges of water levels of optimal habitat compared with sub-optimal habitats, but the differences between the mean habitat ground level and the mean water level is considerably higher in the sub-optimal habitat compared with the optimal habitat (Table 4.5).

Table 4.5 Summary comparisons of the habitats of PZ2 to PZ5, considering the optimal habitats in PZ2 and PZ4 and the sub-optimal habitats in PZ3 and PZ5

	Mean HGL	Mean WL	Min WL	Max WL	Range WL	Mean HGL - mean WL
PPZ2	136.051	135.98	135.26	136.05	0.79m	0.071
PZ4	136.183	136.19	135.95	136.27	0.32m	-0.007
PZ3	136.125	135.969	135.969	136.228	0.259	0.156
PZ5	136.747	136.58	136.18	136.67	0.49	0.167

The overall conclusions from the wet and dry study should be used to inform the design of the abstraction size and control during critical drought periods:

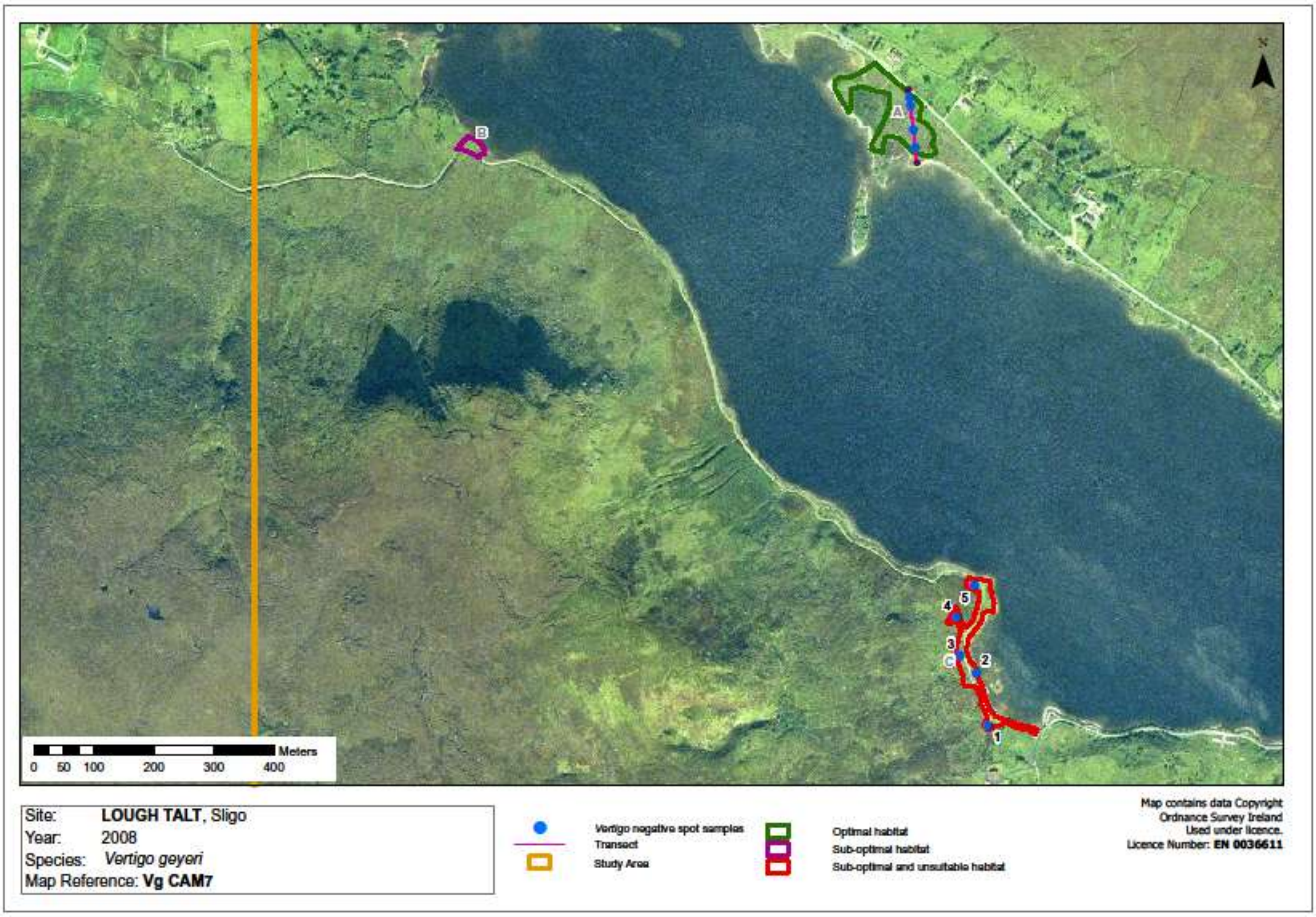
1) *Vertigo geyeri* is a groundwater dependent species found in fen conditions and requires active

flushing groundwater at all times for survival either from direct artesian conditions, or ongoing saturation of ground for the duration of the periods where artesian conditions are slightly below the surface.

2) Abstraction from a lake where the lake levels form part of the water levels in the fen habitat is generally NOT a problem during the vast majority of time when water levels are high and excess water from the catchment is constantly moving from the lake to the river downstream.
3) Abstraction from a lake where the lake levels form part of the water levels in the fen habitat IS a problem when abstraction coincides with drought conditions to draw down the lake to levels where flushing fen conditions can no longer occur.
4) There is no abstraction rate that can be considered to be sustainable without controls that are safeguarded through automatically controlled abstraction restriction to prevent drawdown at high risk periods.
5) A strictly managed abstraction level that is designed to prevent drawdown and always maintain the fen habitat in an actively flushing state could be considered to be a safe system and compatible with the conservation objectives of the site for *Vertigo geyeri*.
6) To achieve the conservation objectives the functional habitat size at designation must be maintained at continuously favourable conditions. Ground surveys have demonstrated that previously optimal areas have reduced in quality. This could be due to changes to vegetation growth and subsequent ground-surface interface permeability during the period of loss of artesian conditions in the period from 2003 to 2007. Over time, with increased protection of artesian conditions, the area of optimal habitat may return to previous levels. However, abstraction levels should not be set at levels that will exclude artesian conditions from currently sub-optimal habitat areas.
7) The habitat to be maintained in optimal conditions is marked as A in Figure 4.1. The transect shown across area a includes PZ1, PZ3, PZ5 and PZ6. PZ2 and PZ4 are located close to this line in areas of excellent habitat. PZ1 and PZ6 are at the extreme ends of the habitat, whereas PZ2, PZ3, PZ4 and PZ5 should all have optimal conditions for the snail.
8) Criteria for design of automatic abstraction controls and triggers should be based on both water level and duration.
9) With regard to water level, *V. geyeri* requires two micro-habitat drivers. One is the water level driving the phreatic pressure, which keeps the moss and sedge root and plant emergent surfaces saturated at all times, and the other is a proximity to small open water pools, which keep humidity high. It was found that the snail requires a consistently damp atmosphere with relative humidity varying between 80% and 95% both summer and winter (Kuczynska & Moorkens, 2010). We can

presume that the same drivers that control phreatic pressure for the flushing habitat also control the small pools, and that the water forms pools where there is lowered micro-topography and/or there is an impeded infiltration area of soil, such as a clay lens. The combinations of these requirements mean that snails are highly restricted in their individual habitat ranges, and do not generally travel more than 5cm in their lifetimes (Kuczynska & Moorkens, 2010). Each metre square may have a number of micro-populations within the overall site population that rarely interact with each other. Temporary loss of a 5cm square of habitat condition can therefore have medium term recovery implications (years), and temporary loss of a few metres square of habitat conditions can result in long term loss (decades) and potentially site extinction.

10) With regard to duration, loss of the snail occurs within days where open water is still present but phreatic conditions are lost (Falkner et al., 2001), or within hours if open water pools have dried and humidity drops below 80% (Kuczynska & Moorkens, 2010). Therefore, controls on abstraction management need to have sufficient early warning to ensure that there is not a time lag during which time evapo-transpiration can extirpate these open water pools (that may only be as small as 10cm x 10cm), and that phreatic conditions are not lost between the trigger, the action and the response in the habitat. This means that controls on abstraction should be designed to ensure a low duration of conditions where they are at the edge of sustainability.
11) Control of artesian conditions could be made using a “hands off” level, controlled by the level of the abstraction outlet pipe.
12) Alternatively, the weir level could be adjusted to provide management of high water levels (to ensure no flooding) and low water levels water is held back and drawdown at the habitat level is prevented. This would require further assessment and possibly planning permission.
13) In either case, an accurate water level that ensures sufficient artesian conditions – and thus active seepages – at all times needs to be found. The fast lethal response (hours to 1-2 days depending on the continued presence of pooled water) of the snail means that the water level must be chosen with a high degree of certainty. This can only be done by relating the microtopography in each 5cm area of optimal habitat with the lake level and setting a trigger that is not so conservative that it makes the abstraction unnecessarily difficult but not at a limit that would cause enough uncertainty or risk that would make an Appropriate Assessment impossible to pass.
14) Saturated ground dries faster in hot temperatures, therefore a temperature trigger may be needed as well as a water level trigger in managing artesian conditions.



5.0 References

Anderson R. (2005). An Annotated List of the Non-Marine Mollusca of Britain and Ireland *Journal of Conchology* **38** No 6: 607-637.

Devillers, P., Devillers-Terschuren, J. & Ledant, J.P. (1991). *Corine biotopes manual – Habitats of the European community. Part 2.* Commission of the European Communities, Luxembourg.

Fossitt, J. (2000). *A guide to habitats in Ireland*. The Heritage Council, Kilkenny.

Kuczynska, A. & Moorkens, E.A. (2010). Micro-hydrological and micro-meteorological controls on survival and population growth of the whorl snail *Vertigo geyeri* Lindholm, 1925 in groundwater fed wetlands. *Biological Conservation* **143,** 1868–1875.

Moorkens, E.A. (1997). *An Inventory Of Mollusca In Potential Sac Sites, With Special Reference To Vertigo Angustior, V. Moulinsiana And V. Geyeri. 1997 Survey.* Unpublished report to National Parks and Wildlife.

Moorkens, E.A. (2006). *Management prescriptions for Vertigo geyeri at cSAC sites for the species in the Republic of Ireland*. Unpublished report to National Parks and Wildlife.

Moorkens, E.A. (2007). *Conservation Assessment of Geyer's whorl snail Vertigo geyeri in Ireland.* Report for National Parks and Wildlife Service.

Moorkens, E.A. (2011). *A molluscan survey of Lough Talt, County Sligo*. Report for RPS.

Moorkens, E.A. (2012). *A monitoring survey for Vertigo geyeri at Lough Talt, County Sligo, during dry conditions*. Report for Sligo County Council.

Moorkens, E.A. & Killeen, I.J. (2011). Monitoring and Condition Assessment of Populations of *Vertigo geyeri*, *Vertigo angustior* and *Vertigo moulinsiana* in Ireland. *Irish Wildlife Manual*s, No. 55. National Parks and Wildlife Service, Department of Arts, Heritage and Gaeltacht, Dublin, Ireland.

Rodwell, J.S. (1991). *British plant communities Volume II: Mires and Heaths*. Cambridge University Press, Cambridge.

Romão, C. (1996). *Interpretation manual of European Union habitats*. Version EUR 15. European Commission, Brussels.

RPS (2014). RPS Consulting Engineers (Galway) (2014) *Lough Talt hydrogeological impact assessment report.* Report to Sligo county Council.

APPENDIX D – LOUGH TALT HYDROGEOLOGICAL IMPACT ASSESSMENT REPORT

RPS

LOUGH TALT HYDROGEOLOGICAL IMPACT ASSESSMENT REPORT

LOUGH TALT HYDROGEOLOGICAL IMPACT ASSESSMENT REPORT

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	Name	Position	Signature	Date
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EXECUTIVE SUMMARY

RPS has undertaken a hydrogeological investigation and impact assessment of the Vertigo geyeri habitat on the eastern shore of Lough Talt, Co. Sligo. The purpose of the investigation was to assess the linkage between the lake water levels and the groundwater flushes that support the habitat. The results of the assessment were used to determine the potential impact of water abstraction from the lake for human consumption on the Vertigo geyeri habitat.

The Vertigo geyeri habitat is located in the peat soils of the fen. The site investigation results have shown the habitat is underlain by a gravel aquifer that extends to at least 15m below ground level. The groundwater flow direction is towards the lake and the lake is considered to be in hydraulic continuity with the gravel aquifer and act as a discharge boundary for the groundwater flow through the gravel deposit.

Monitoring of the piezometers within the habitat area shows the groundwater level in the shallow peat soils drops below ground level during extended dry periods. When the head in the underlying gravel aquifer drops below ground level it no longer supports the surface groundwater discharges and the habitat requirements for the snail.

Analysis of the head distributions throughout the gravel aquifer have shown that these are directly controlled by the lake level during dry conditions when any influence of direct precipitation is absent. Therefore reducing lake levels during a dry period draws down the groundwater levels in the gravel aquifer on the lake shore resulting in cessation of artesian conditions.

Analysis of the logger data has shown the cessation of artesian conditions occurs at PZ2, PZ3 and PZ4 when the lake level drops below 135.66maod. The current lake abstraction operation results in the lake level dropping below this level on an annual basis during dry weather. The continued abstraction from the lake, when the water level drops below this elevation, has an impact on the artesian conditions within the fen and therefore the supporting conditions for the habitat.

RPS has developed a lake water balance model to assess an abstraction management approach to mitigate impacts on the habitat. The assessment includes a *trigger level,* at which point the lake abstraction is reduced to 4,000m^3/d (approximately half the normal abstraction rate), and a lower *hands off level*, at which point that abstraction is ceased entirely.

The modelling has shown a number of scenarios exist for the successful management of the lake water levels depending on how frequently a complete cessation of abstraction and/or the reduced rate is adopted. A trigger level of 135.73maod results in virtually no instances over the test period where the lake level drops below the hands off level. In this scenario the requirement for reduced abstraction is required on average 95 days a year.

If the modelled reduction in abstraction rate is applied then the potential impact of the lake abstraction is estimated to be slight beneficial impact as it could lead to an increased area of optimal habitat within the fen.

An alternative water supply source will be required to supplement the supply where the abstraction is reduced to 4,000m^3/d. RPS understands there are options for alternative water supplies in the north-west region that are being investigated.

RPS recommends that groundwater monitoring at Lough Talt is continued for the foreseeable future. RPS recommends that biannual site visits are completed by a hydrogeologist to download the level loggers, manually record the groundwater levels to allow for logger calibration.

TABLE OF CONTENTS

TABLES

FIGURES (compiled at end of report)

1. INTRODUCTION

This report presents the results of a hydrogeological impact assessment which assesses the potential impact of on-going water abstraction from Lough Talt on groundwater levels in the immediate vicinity of the lake and the groundwater supporting conditions for the Groundwater Dependant Terrestrial Ecosystem (GWDTE) adjacent the lake.

Lough Talt is located on the eastern slopes of the Ox Mountains in County Sligo, see Figure 1. The Lough Talt catchment is steeply sloped with ground elevations ranging from 136 – 300 mAOD (Malin Head Datum). The elevation of the general area surrounding the lake ranges from 136 – 160 mAOD.

Irish Water (IW) currently abstracts approximately 7,500m^3/d from an intake point located in the southern area of the lake. Water has been abstracted from the lake since the 1950s. Irish Water have applied for Planning Permission to construct a new water treatment plant for the Lough Talt supply with a capacity of 8,000m^3/d.

An Bord Pleanala have requested that a revised Natura Impact Statement (NIS) be submitted incorporating a thorough examination of the impacts of the continued water abstraction on the adjacent European Protected sites, including Lough Hoe Bog Special Area of Conservation (SAC) which contains the Vertigo geyeri snail habitat (SAC No. 000633). A key feature of the *Vertigo geyeri* habitat is its dependence on groundwater discharges (flushes) within the fen environment.

This report summarises the investigation and monitoring programme completed to develop the baseline characterisation. The report presents the monitoring results for the piezometer water levels within the fen area. The report provides an analysis of the interaction between the lake levels, groundwater level and the supporting habitat conditions. In conclusion the report provides a recommended lake level management protocol to mitigate potential impacts on the supporting groundwater conditions for the habitat.

2. HYDROGEOLOGICAL ENVIRONMENT

There are four main aquifer types relevant to this hydrogeological assessment of the Lough Talt fen.

2.1 Bedrock

The bedrock geology type underlying Lough Talt is Precambrian Quartzites, Gneisses and Schists. The fen site is underlain by the Meelick Member comprising mainly schists. The bedrock aquifer underlying the site is classed by the Geological Survey of Ireland (GSI) as a poor aquifer (PI) which is generally unproductive except for local zones.

The Lough Talt catchment lies within the Foxford Groundwater Body, which is characterised by low transmissivities of 0.1-10 m^2/d. The depth to bedrock is greater than 15 metres as it was not encountered during drilling at the site.

2.2 Gravel

A layer of medium to coarse gravels, at least 10.5m thick, was encountered during drilling of BH1d and BH2d. Both bores are located adjacent to the fen area on the track that traverses the northern area of the inlet. In BH3d, drilled on the hill 94m north east of the BH1d, a gravel layer of at least 12m was also encountered.

The falling and rising head tests conducted on all three bores screened in the gravel layers indicated a high permeability. A literature derived representative permeability value for the gravel is 1×10^{-4} m/s.

2.3 Subsoil

Subsoil of between 3 and 5 meters thickness was observed during the drilling the four boreholes on the lakeshore inlet. In both BH1d and BH2d, this sub-soil was separated from the lower gravel aquifer by an approximately 2.5m thick clay layer. This subsoil and clay layer was not encountered in BH3d.

The falling and rising head tests conducted on the two boreholes screened in this subsoil (BH1s and BH2s) indicated a permeability of between 1×10^{-5} and 2×10^{-6} m/s. The permeability of the clay is expected to be lower than 1×10^{-9} m/s; this is based on field observations of the consistency of this layer and typical literature values.

2.4 Peat

Peat thickness varies across the fen area ranging between 0.07m and 1.60m. The six piezometers installed across the main habitat area, where groundwater seepages are observed, ranged in depth between 0.07m and 0.84m. The recovery tests conducted on the piezometers indicated variable permeability for the peat across the fen area.

2.5 Conceptual Site Model

A Conceptual Site Model (CSM) section is presented in Figure 2.1. This illustrates that the fen habitat is underlain by a thick gravel deposit with a thin variable cover of peat. Groundwater flows from the up-gradient areas of higher elevation towards the lake. The lake acts as a hydraulic boundary for groundwater flow in the area and therefore the lake level exerts a significant influence on groundwater levels in the immediate vicinity of the lake, in particular the artesian conditions in the fen habitat.

3. SITE INVESTIGATION RESULTS

3.1 Scope of Work

The hydrogeological site investigation completed on site consisted of the following aspects:

- Drilling of groundwater monitoring boreholes into sands and gravels, and subsoil till located outside the perimeter of the habitat.
- Installation of six shallow piezometers within the fen area.
- Installation of water level, temperature and electrical conductivity (EC) logging equipment in a selected number of boreholes and piezometers.
- Water quality sampling from the boreholes and piezometers.
- Soil depth profiling across the fen area.
- Topographic survey of the boreholes, piezometers and habitats.

The results of the site investigations have been detailed in previous RPS reports (RPS 2013) and therefore only the most relevant aspects are summarized here.

3.2 Piezometer Installation

Groundwater monitoring within the habitat area was achieved using shallow piezometers (also referred to as phreatic tubes). The piezometers comprise one metre lengths of perforated stainless steel pipe with a 32mm outer diameter. The piezometers were inserted into the soil by hand by the site investigation sub-contractor. The perforations from the top of the piezometers to 0.8m were sealed using duct tape; the open area from 0.8-1.0m will be used to monitor groundwater levels across the habitat. All six piezometers were installed to the point of refusal.

The piezometers were located adjacent to the habitat monitoring transects and also adjacent to any other springs on the fen. The locations were agreed onsite with the ecologist and the installations were supervised by the on-site ecologist and hydrogeologist. This ensured that they were placed close enough to monitor representative groundwater levels, while not damaging the key habitat area. Final locations for the piezometers are detailed in Table 3.1 and presented in Figure 1.1. The piezometers were surveyed in as part of the original topographic survey at the site. The steel piezometers were initially fitted with a stainless steel cap however this was found to have corroded after two years of monitoring and was replaced with a PVC cap.

Table 3.1 Piezometer Construction Details

Bore ID	Coordinates		Ground Elevation (maod)	Construction Details			
	Easting (m)	Northing (m)		Total Depth (mbtoc) (mbgl)	Top of Casing (magl)	Sealed Interval (mbtoc)	Depth to top of Screened Interval (mbgl)
PZ1	139691	315513	136.63	1 (0.48)	0.52	0-0.8	0.28
PZ2	139695	315520	136.21	1 (0.76)	0.14	0-0.8	0.66
PZ3	139689	315531	136.47	1 (0.71)	0.29	0-0.8	0.51
PZ4	139700	315530	136.37	1 (0.88)	0.12	0-0.8	0.68
PZ5	139689	315550	136.87	1 (0.83)	0.17	0-0.8	0.63
PZ6	139689	315575	137.47	1 (0.70)	0.30	0-0.8	0.50

mAOD = metres above ordnance datum; mbtoc = meters below top of casing; mbgl = metres below ground level
magl = meters above ground level; Logger Installation

3.3 Logger Installations

Following the installation of the boreholes and piezometers water level-loggers were installed in two of the deep and one of the shallow borehole locations, and two of the piezometers. These loggers are programmed to record water level (WL) and temperature fluctuations every four hours. In addition, three loggers recording conductivity were installed in three of the piezometers. See Table 3.2 for logger locations and measuring capabilities.

The installed loggers are Solinst Level-logger Edge Series (pressure, water level and temperature measurements) and Aqua Troll loggers (conductivity measurements). The loggers were positioned inside the boreholes and piezometers and are suspended underwater by metal wire that is attached to the top of the borehole/piezometer casing. Additional level loggers were installed in PZ1, PZ3, PZ4 and PZ6 in March 2016.

Table 3.2: Groundwater Logger Details

Name	Logger Type	Serial number	Monitored Parameters		Start of Record
			Conductivity	Level & Temperature	
PZ1	Aqua TROLL	149527	X		Mar 2013
	Levelogger	2057154		X	Mar 2016
PZ2	Levelogger	2016795		X	Mar 2013
PZ3	Levelogger	2057158		X	Mar 2016
PZ4	Aqua TROLL	132006	X		Mar 2013
	Levelogger	2057173		X	Mar 2016
PZ5	Levelogger	2020179		X	Mar 2013
PZ6	Aqua TROLL	146233	X		Mar 2013
	Levelogger	2057152		X	Mar 2016
BH1d	Levelogger	2019198		X	Mar 2013
BH1s	Levelogger	2017479		X	Mar 2013
BH3d	Levelogger	2019150		X	Mar 2013
BH2d	Levelogger	2017845	Barometric pressure (Kpa)		Mar 2013

3.4 Topographic Survey

The monitoring points were surveyed to ordnance datum to allow the groundwater levels to be assessed in the context of the lake elevation. The key features surveyed included boreholes, piezometers and springs on the site. The lake level was also surveyed to ensure the results could be tied into the existing lake level monitoring. The surveying was completed using GPS on 5th June 2013 by Murphy Surveys Ltd under the supervision of the hydrogeologist. The average accuracy of the surveyed elevations was $\underline{+}$0.02m.

4. WATER MONITORING RESULTS

4.1 Groundwater Levels results

Chart 4.1 presents the lake and piezometer water level between April 2016 and September 2016. This illustrates the lake is at the lowest elevation compared to the piezometers and the groundwater elevation increases in the piezometers with increasing distance back from the lake with the lowest levels recorded in PZ1 and the highest elevations in PZ6.

There is a significant dry period recorded in late May to mid-June 2016. During this period the varied responses of the piezometer groundwater levels can be observed.

Chart 4.1: Piezometer and Lake Water Levels

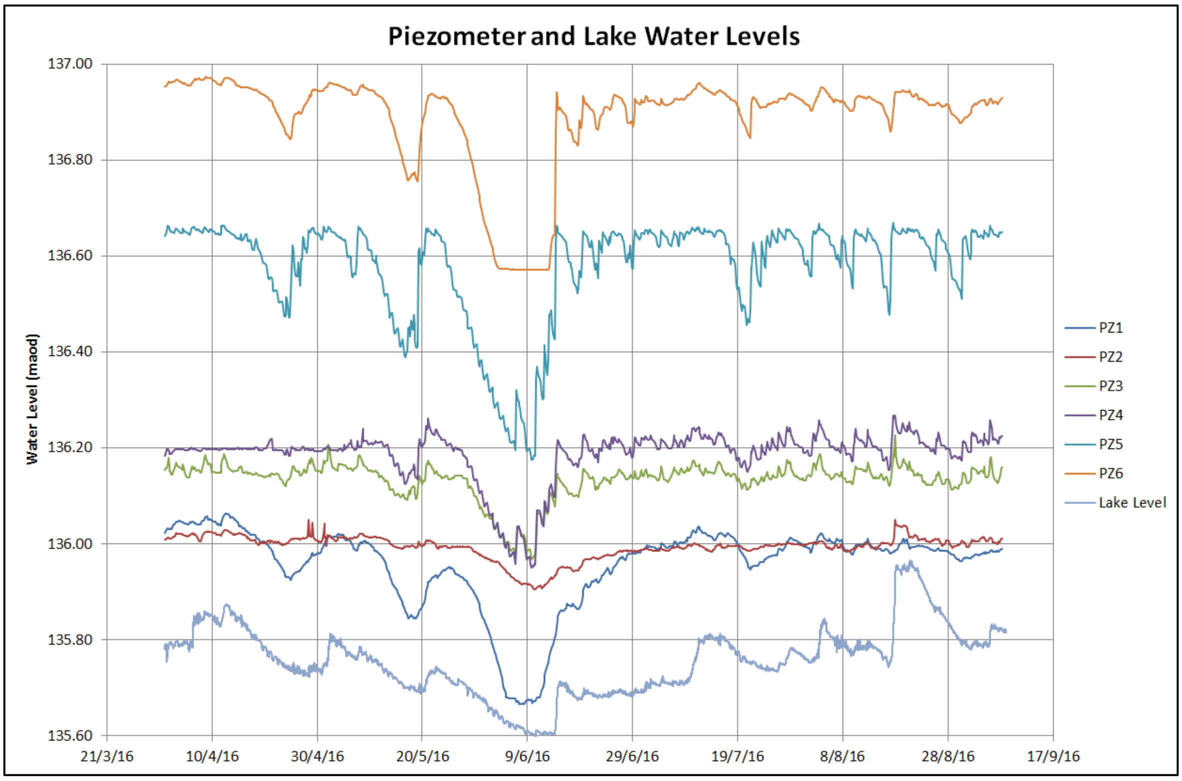
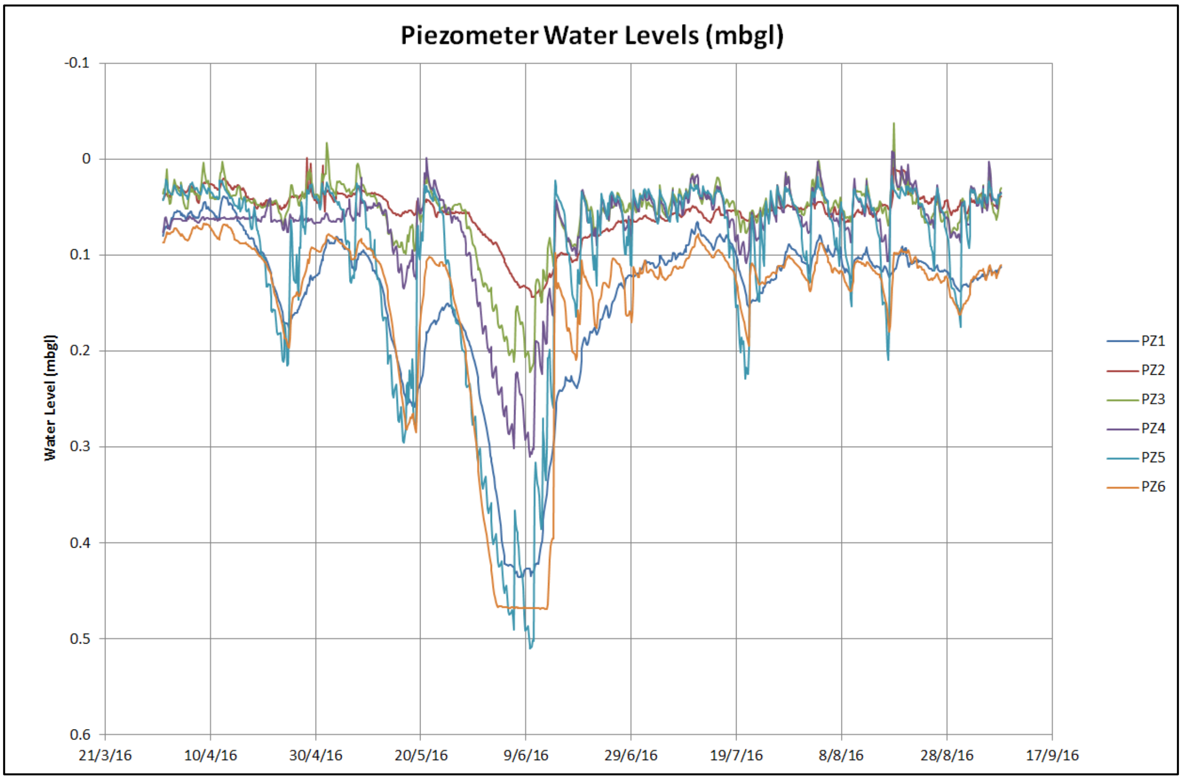


Chart 4.2 presents the piezometer water level relative to the ground elevation at the piezometer. This illustrates there is a relatively limited range of water level fluctuation over the majority of the monitored period however during extended dry periods the water levels drop up to 0.5m. The varied responses between the loggers is clear again with PZ1, PZ5 and PZ6 showing the greatest drop in water levels and PZ2, PZ3 and PZ4 showing a less significant drop. The lowest level at PZ6 bottoms out in June 2016 as the water level drops below the base of the piezometer.

Chart 4.2: Piezometer Levels (mbgl)



Charts 4.3 and 4.4 present the correlation between lake levels during the September 2014 extended dry period and the piezometer levels observed at PZ2 and PZ5. This shows a clear correlation between the two datasets during these dry weather periods.

Chart 4.3: PZ2 Groundwater Level and Lake Levels

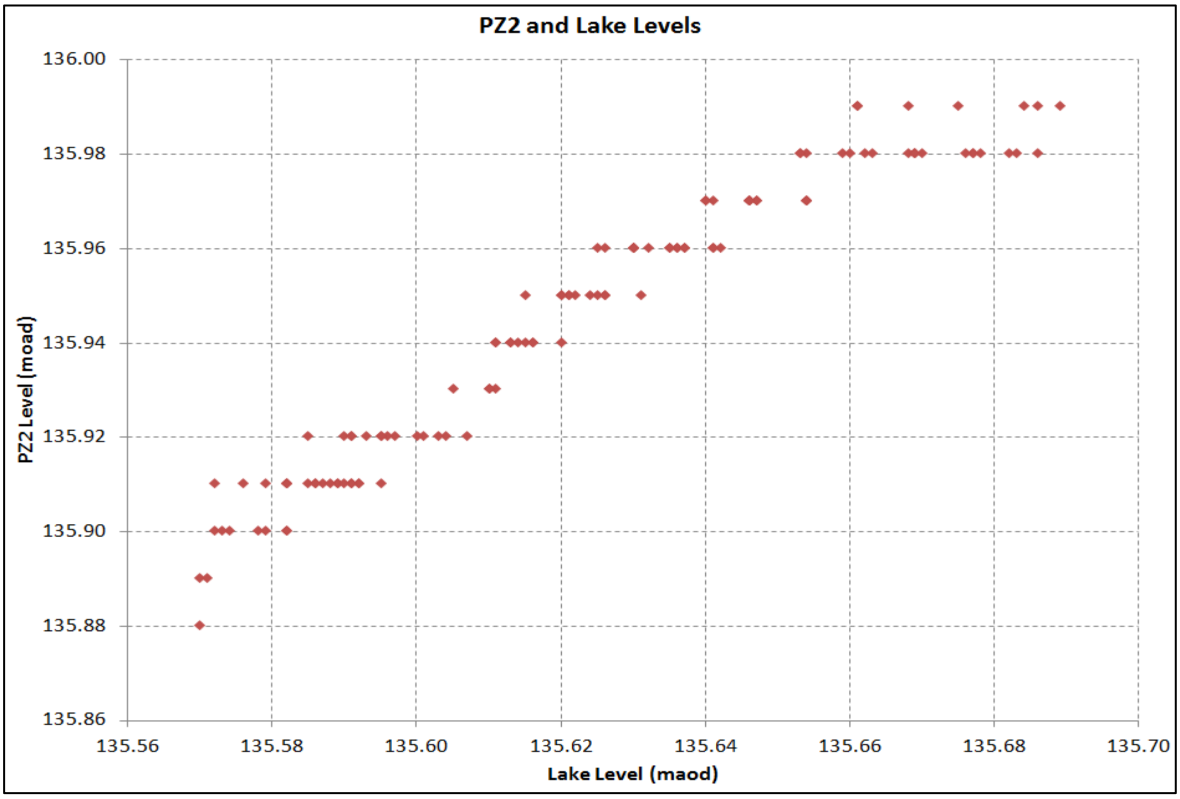
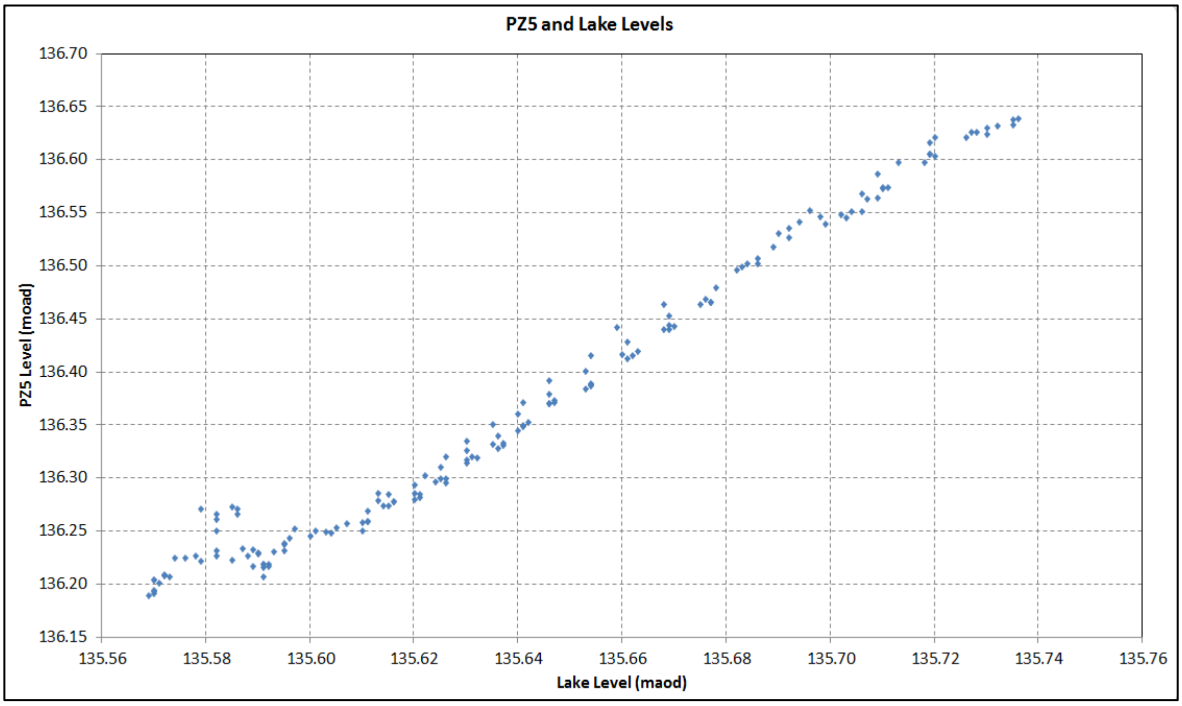


Chart 4.4: PZ5 Groundwater Level and Lake Level



4.2 Groundwater Flow Direction and Gradients

Horizontal gradients across the habitat from PZ1 to PZ6 are from north-east to south-west across the fen area, with water levels decreasing towards the lake. Figure 4.1 presents a groundwater elevation contour map for the site which illustrates the groundwater flow direction as being towards the lake.

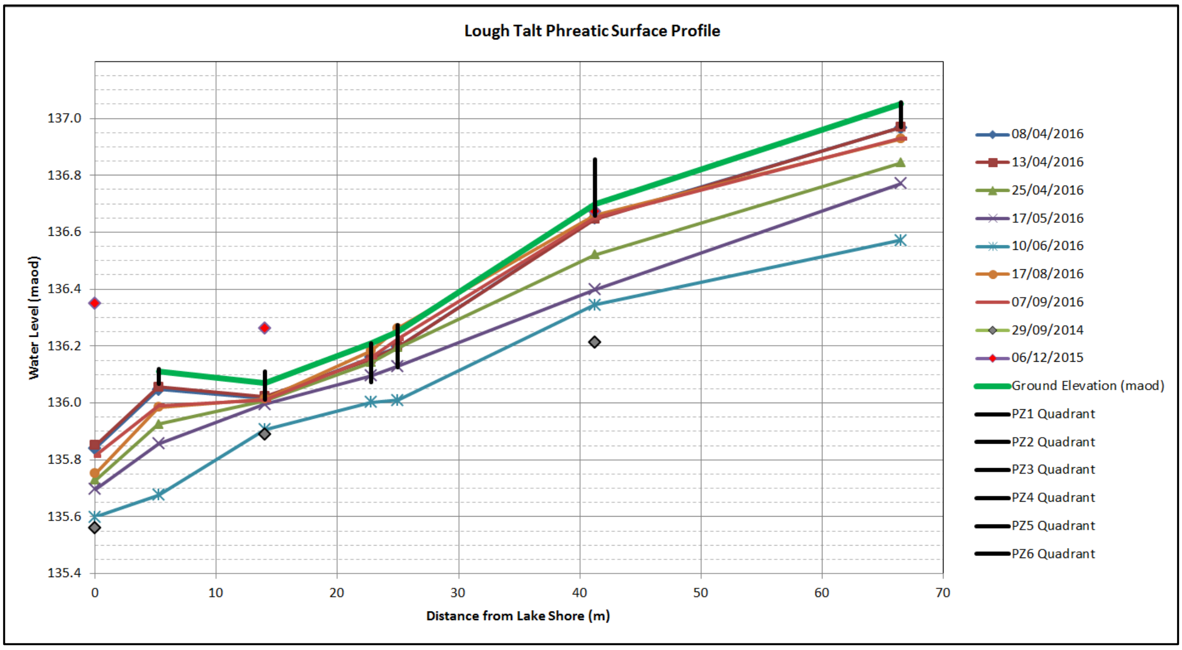
There is an upward vertical hydraulic gradient through the gravels which emerges as the artesian flushes supporting the fen habitat. This hydraulic gradient and the variations between the shallow subsoil and deep gravels is observed in the nested boreholes (BH1 and BH2) installed adjacent the habitat.

Chart 4.5 presents a section through the habitat area illustrating the observed piezometer and lake levels on a range of dates. This illustrates the correlation between the lake water level and the groundwater levels measured in the piezometers.

The data is presented with the topographic range measured within the ecology quadrant during the micro-topography survey as a thick black vertical line for each piezometer location. It illustrates that for PZ2, PZ3 and PZ4, which are surrounded by the greatest proportion of optimal habitat areas, the groundwater level is within the topographic range observed within the ecology quadrant over the majority of the observed water level conditions except the driest. The levels for PZ1, PZ5 and PZ6 where optimal habitats are rarely if ever recorded are more frequently outside the topographic range.

The lake acts as a hydraulic boundary to groundwater flow as it is the ultimate discharge feature for local groundwater. As a boundary condition the lake has a controlling influence on groundwater levels in the immediate vicinity of the lake.

Chart 4.5: Lough Talt Phreatic Surface Profiles



4.3 Lake Water Levels and Discharge

Lake water levels have been monitored by an automatic logger at 15 minute intervals since 2013. The overflow discharge rate to the downstream surface water channel is also measured at 15 minute intervals. Chart 4.6 presents the lake water levels and overflow discharge rate from 2014 to 2016.

This illustrates a clear relationship between lake level and overflow and that the lake overflow reduces to zero at low lake water levels, typically below 135.62moad.

Chart 4.6: 2016 Lake Logger Data

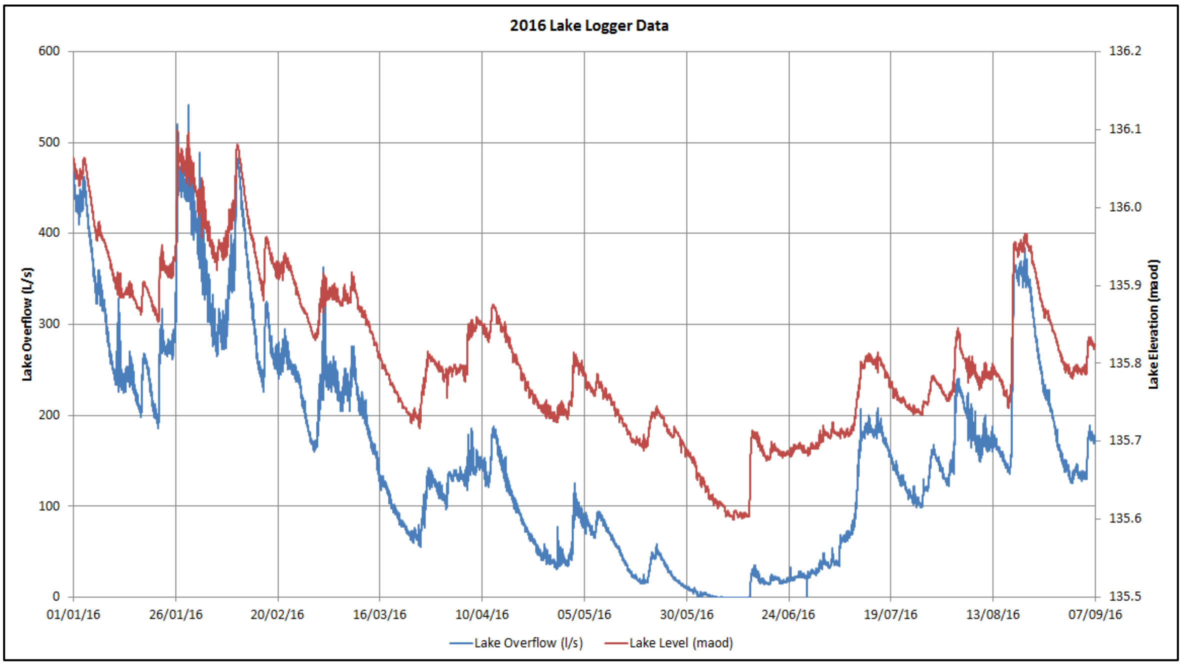
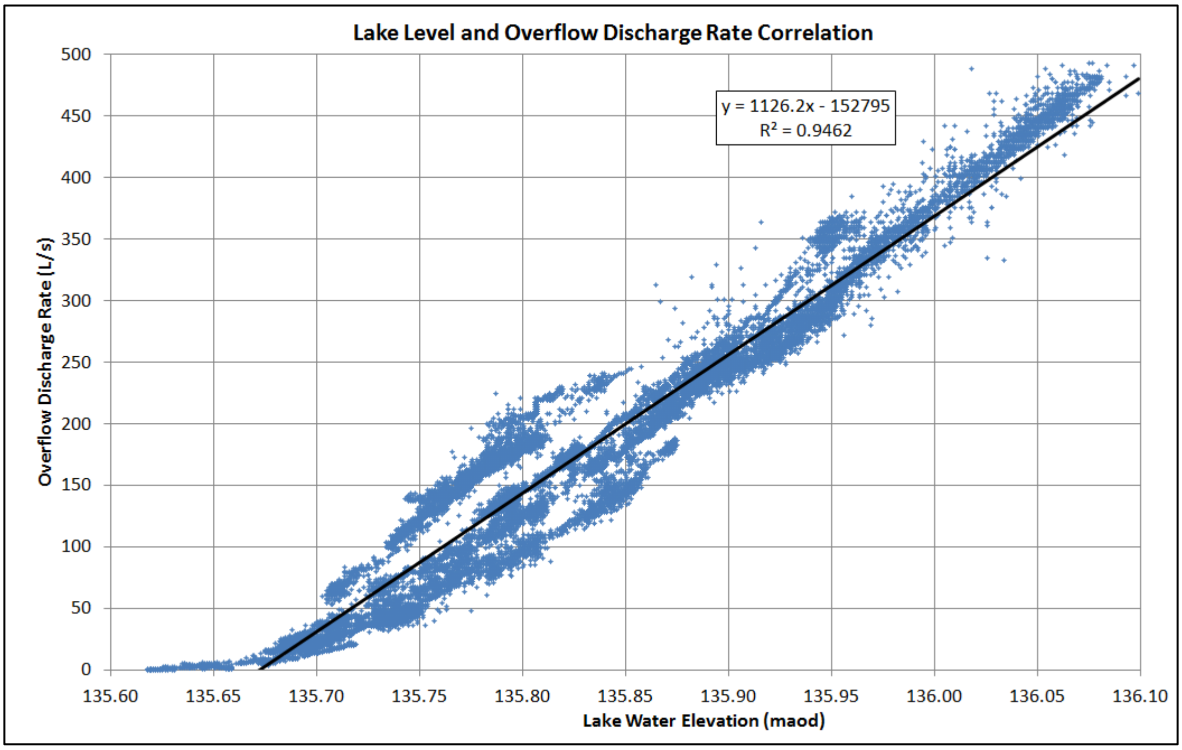


Chart 4.7 presents a correlation between the lake level and overflow discharge rate. This chart is presented with a linear trend line which shows a strong regression (R^2 - 0.95) over the majority of the range of observations.

Chart 4.7: Lake Level and Overflow Discharge Rate Correlation



5. HYDRO-ECOLOGY

5.1 Micro-topography and Piezometery

The micro-topography data presented in Moorkens 2016 is combined with the water level measurements recorded at the piezometers to assess the relationship between the groundwater elevation and the topography.

Tables 5.1 to 5.4 present two datasets for each piezometer including the ground elevation measured in the quadrant and the percentage of time that the water level in the piezometer was above the elevation at that quadrant grid. This illustrates the percentage of time the grid square within the quadrant can be considered to experience artesian conditions and potentially receive groundwater discharges.

There will be localised variations in subsoil permeability, even at the sub-quadrant scale, which may affect the groundwater flushing rate even where artesian conditions exist. Also the level monitored in the piezometer is representative of the piezometric head at the lower 20cm of the installed piezometer depth and the minor variations in head due to the vertical head gradient in the soil between the base of the piezometer and the ground surface may mean the piezometer level is not representative of the head at the ground surface. In addition, this approach extrapolates the head measured in the piezometer across the entire quadrant when in fact there will be localised spatial variations in head due to the local head gradient reduction from land side towards the lake shore.

The results for PZ1 and PZ6 are not presented as there is virtually no overlap between the topography and the lake level. The results for PZ2 to PZ5 show variation in the relative amount of time and proportion of the quadrant that experience artesian conditions. In particular PZ3 and PZ4 show a strong overlap whereas there is a less pronounced overlap in PZ2 and PZ5. The results for PZ4 link well with the observed surface water ponding recorded in the bottom left corner of the quadrant (A10) which appears to experience artesian conditions over 90% of the time.

The levels at PZ2 show a relatively low level of saturation, however the water level is in fact only marginally below the surface and when a comparable calculation is performed assessing the level of saturation 2cm below the surface there is a significantly higher overlap. The capillary fringe within the soil horizon may extend over the top 2cm of the soil horizon such that significant moisture content would be retained at surface.

Table 5.1: PZ2 Comparison between topography and water level.

Elevation	A	B	C	D	E	F	G	H	I	J
1	136.075	136.096	136.078	136.056	136.041	136.043	136.049	136.051	136.064	136.079
2	136.073	136.057	136.066	136.058	136.043	136.031	136.037	136.043	136.050	136.061
3	136.026	136.032	136.050	136.050	136.040	136.040	136.045	136.047	136.018	136.038
4	136.039	136.060	136.072	136.061	136.040	136.069	136.051	136.059	136.048	136.031
5	136.060	136.051	136.064	136.070	136.045	136.047	136.035	136.048	136.047	136.036
6	136.065	136.064	136.093	136.110	136.090	136.063	136.042	136.053	136.037	136.044
7	136.071	136.055	136.057	136.063	136.055	136.061	136.046	136.042	136.050	136.058
8	136.028	136.033	136.030	136.045	136.046	136.050	136.042	136.030	136.013	136.026
9	136.048	136.052	136.041	136.046	136.045	136.053	136.040	136.041	136.029	136.033
10	136.053	136.038	136.032	136.053	136.051	136.049	136.042	136.075	136.044	136.046
% Artesian	A	B	C	D	E	F	G	H	I	J
1	1%	1%	1%	2%	5%	5%	4%	3%	1%	1%
2	1%	2%	1%	2%	5%	10%	7%	5%	4%	1%
3	17%	10%	4%	4%	6%	6%	4%	4%	26%	6%
4	6%	2%	1%	1%	6%	1%	3%	2%	4%	10%
5	2%	3%	1%	1%	4%	4%	8%	4%	4%	7%
6	1%	1%	1%	0%	1%	1%	5%	3%	7%	4%
7	1%	3%	2%	1%	3%	1%	4%	5%	4%	2%
8	14%	9%	12%	4%	4%	4%	5%	12%	31%	17%
9	4%	3%	5%	4%	4%	3%	6%	5%	13%	9%
10	3%	6%	10%	3%	3%	4%	5%	1%	4%	4%

Table 5.2: PZ3 Comparison between topography and water level

	A	B	C	D	E	F	G	H	I	J
1	136.153	136.136	136.123	136.156	136.143	136.131	136.154	136.189	136.211	136.170
2	136.120	136.135	136.154	136.157	136.171	136.138	136.147	136.170	136.184	136.190
3	136.118	136.108	136.145	136.126	136.125	136.117	136.133	136.163	136.160	136.155
4	136.102	136.117	136.100	136.091	136.085	136.120	136.098	136.122	136.118	136.122
5	136.109	136.120	136.106	136.113	136.124	136.107	136.091	136.105	136.110	136.130
6	136.107	136.141	136.193	136.158	136.159	136.105	136.103	136.106	136.107	136.111
7	136.072	136.165	136.195	136.170	136.141	136.126	136.107	136.108	136.115	136.123
8	136.157	136.171	136.127	136.118	136.111	136.130	136.106	136.110	136.150	136.166
9	136.150	136.146	136.100	136.088	136.096	136.130	136.117	136.130	136.168	136.155
10	136.170	136.136	136.142	136.132	136.156	136.163	136.134	136.125	136.128	136.148
% Artesian	A	B	C	D	E	F	G	H	I	J
1	27%	67%	81%	21%	50%	74%	24%	0%	0%	5%
2	82%	68%	24%	19%	5%	62%	40%	5%	1%	0%
3	84%	87%	45%	79%	80%	84%	72%	12%	15%	22%
4	89%	84%	90%	91%	91%	82%	90%	81%	84%	81%
5	87%	82%	87%	86%	80%	87%	91%	87%	86%	75%
6	87%	55%	0%	18%	16%	87%	88%	87%	87%	86%
7	92%	10%	0%	5%	55%	79%	87%	87%	85%	81%
8	19%	5%	78%	84%	86%	75%	87%	86%	34%	9%
9	34%	43%	90%	91%	91%	75%	84%	75%	7%	22%
10	5%	67%	53%	73%	21%	12%	70%	80%	77%	38%

Table 5.3: PZ4 Comparison between topography and water level

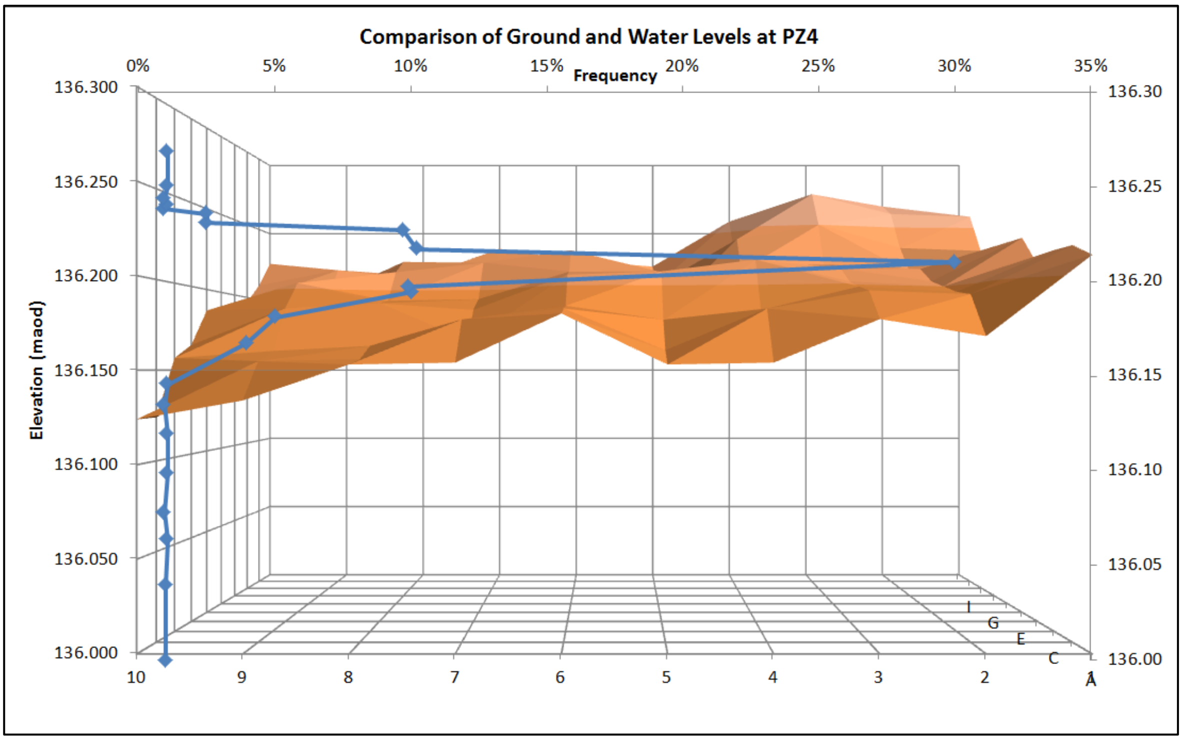
	A	B	C	D	E	F	G	H	I	J
1	136.211	136.219	136.219	136.213	136.232	136.214	136.229	136.230	136.259	136.245
2	136.168	136.192	136.195	136.200	136.205	136.215	136.215	136.234	136.261	136.270
3	136.177	136.194	136.198	136.203	136.213	136.218	136.213	136.250	136.275	136.273
4	136.154	136.184	136.184	136.216	136.202	136.217	136.216	136.240	136.239	136.259
5	136.153	136.161	136.179	136.209	136.211	136.205	136.185	136.183	136.209	136.226
6	136.180	136.184	136.187	136.207	136.211	136.227	136.215	136.221	136.228	136.212
7	136.154	136.178	136.167	136.186	136.194	136.219	136.211	136.202	136.222	136.239
8	136.153	136.156	136.164	136.190	136.193	136.213	136.222	136.197	136.215	136.219
9	136.134	136.155	136.161	136.187	136.204	136.167	136.185	136.201	136.221	136.213
10	136.124	136.124	136.157	136.165	136.187	136.185	136.175	136.197	136.210	136.228
% Artesian	A	B	C	D	E	F	G	H	I	J
1	29%	17%	17%	26%	7%	25%	9%	8%	0%	2%
2	85%	73%	69%	46%	37%	24%	24%	6%	0%	0%
3	82%	71%	56%	40%	26%	18%	26%	1%	0%	0%
4	88%	79%	79%	22%	42%	20%	22%	4%	4%	0%
5	88%	87%	81%	32%	29%	37%	78%	79%	32%	11%
6	81%	79%	77%	35%	29%	10%	24%	15%	9%	27%
7	88%	82%	85%	78%	71%	17%	29%	42%	14%	4%
8	88%	88%	86%	74%	72%	26%	14%	61%	24%	17%
9	90%	88%	87%	77%	38%	85%	78%	44%	15%	26%
10	91%	91%	88%	86%	77%	78%	83%	61%	30%	9%

Table 5.4: PZ5 Comparison with topography and water level

	A	B	C	D	E	F	G	H	I	J
1	136.686	136.667	136.669	136.700	136.736	136.801	136.840	136.856	136.836	136.821
2	136.706	136.674	136.681	136.670	136.702	136.788	136.834	136.850	136.835	136.824
3	136.717	136.687	136.690	136.699	136.704	136.721	136.748	136.767	136.765	136.760
4	136.708	136.687	136.698	136.707	136.700	136.696	136.735	136.756	136.759	136.659
5	136.698	136.694	136.696	136.715	136.709	136.717	136.730	136.737	136.731	136.735
6	136.706	136.698	136.707	136.713	136.718	136.721	136.717	136.712	136.716	136.707
7	136.734	136.731	136.723	136.721	136.715	136.709	136.705	136.707	136.699	136.714
8	136.733	136.744	136.750	136.749	136.736	136.730	136.719	136.707	136.700	136.706
9	136.737	136.750	136.754	136.760	136.745	136.760	136.734	136.708	136.710	136.743
10	136.744	136.761	136.742	136.754	136.747	136.755	136.743	136.710	136.727	136.797
% Artesian	A	B	C	D	E	F	G	H	I	J
1	10%	23%	21%	7%	0%	0%	0%	0%	0%	0%
2	5%	16%	12%	20%	6%	0%	0%	0%	0%	0%
3	4%	9%	9%	7%	6%	3%	0%	0%	0%	0%
4	5%	9%	7%	5%	7%	8%	1%	0%	0%	31%
5	7%	8%	8%	4%	5%	4%	1%	0%	1%	1%
6	5%	7%	5%	4%	4%	3%	4%	4%	4%	5%
7	1%	1%	2%	3%	4%	5%	6%	5%	7%	4%
8	1%	0%	0%	0%	0%	1%	3%	5%	7%	5%
9	0%	0%	0%	0%	0%	0%	1%	5%	5%	0%
10	0%	0%	0%	0%	0%	0%	0%	5%	2%	0%

Chart 5.1 presents this same data in a spatial, semi-3D manner by representing the elevation data as a surface and then overlaying with that the frequency distribution chart for the piezometer water level. This illustrates that for the majority of the time the water level is within the elevation range across the quadrant. The water level only drops below or rises significantly above the topography for a relatively minor proportion of the time.

Chart 5.1: Comparison of Topography and Groundwater Levels at PZ4



6. IMPACT ASSESSMENT

6.1 Proposed Development

The Lough Talt Regional Water Supply Scheme (RWSS) serves an approximate population of 13,500 and has used Lough Talt as its raw water source since the 1950's. The existing scheme has a number of deficiencies including inadequate water treatment leading to high levels of Trihalomethanes (THMS), a very high risk of Cryptosporidium in the raw water and distribution network issues (lack of treated water storage capacity, sub-standard water pipes, etc). Improvement works are required in order to protect public health and to comply with the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278 of 2007).

The relevant works proposed during this phase of the development of the Lough Talt RWSS include the development of a new water treatment plan with the capacity to treat 8,000m^3/d. The current average abstraction rate from the lake to the plant is on average approximately 7,500m^3/d with typical daily range of approximately $\pm$200m^3/d.

6.2 Receptor Sensitivity

The Vertigo geyeri habitat requires a consistent seepage of calcareous groundwater along the shores of the lake. Moorkens (2016) states the water level criteria for the lake must maintain the supporting artesian conditions in the optimal and suboptimal habitat areas. Persistent optimal conditions are observed at PZ2 and PZ4 while only sub-optimal and seasonal optimal conditions are observed at PZ3 and PZ5. There are no optimal or suboptimal conditions observed at PZ1 and PZ6.

6.3 Predicted Potential Impact

Charts 6.1 to 6.4 present the correlation between lake level and piezometer water level over the observed data range. The charts illustrates that the majority of the piezometer water level data cluster within the artesian water level range. The groundwater levels are drawn down below this artesian range during low lake levels. The lake elevation that coincides with the groundwater level drawdown for PZ2, PZ3 and PZ4 is approximately 135.66moad. The recession at PZ5 occurs at a wider range of lake elevations which may be related to the increased distance from the lake shore to PZ5.

Charts 6.2 and 6.3 illustrate the separate recession and re-wetting limb for PZ3 and PZ4. Rewetting at the piezometer occurs when rainfall after an extended dry period occurs and wets up the soil causing the level in the piezometer to rise. The groundwater level rises at a faster rate than the lake as the rainfall fills the void space in the soil (possibly 20% of total volume) much quicker than the lake fills up, where essentially the void space is 100%. Close inspection of the rewetting on the piezometer hydrographs show the groundwater levels rise intermittently during the rainfall onset but drop back down to the level correlated with the lake elevation if rainfall is not sustained. This again supports the concept of the lake as the ultimate hydraulic boundary for the groundwater.

Chart 6.1: PZ2 and Lake Levels

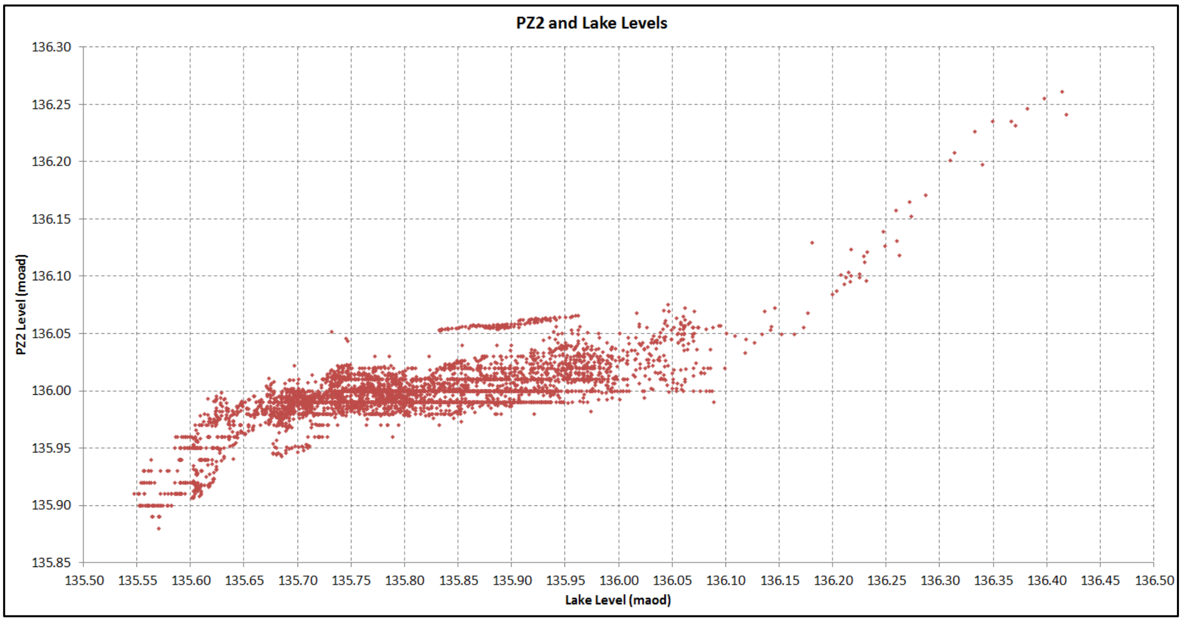


Chart 6.2: PZ3 and Lake Levels

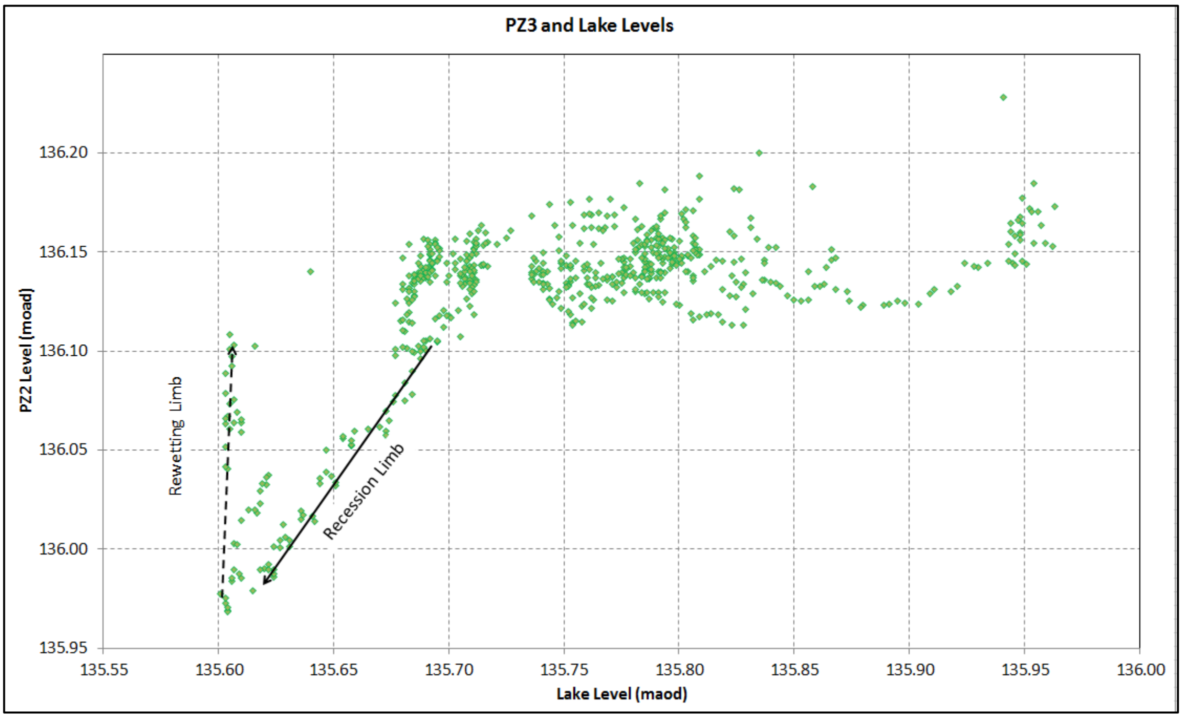


Chart 6.3: PZ4 and Lake Levels

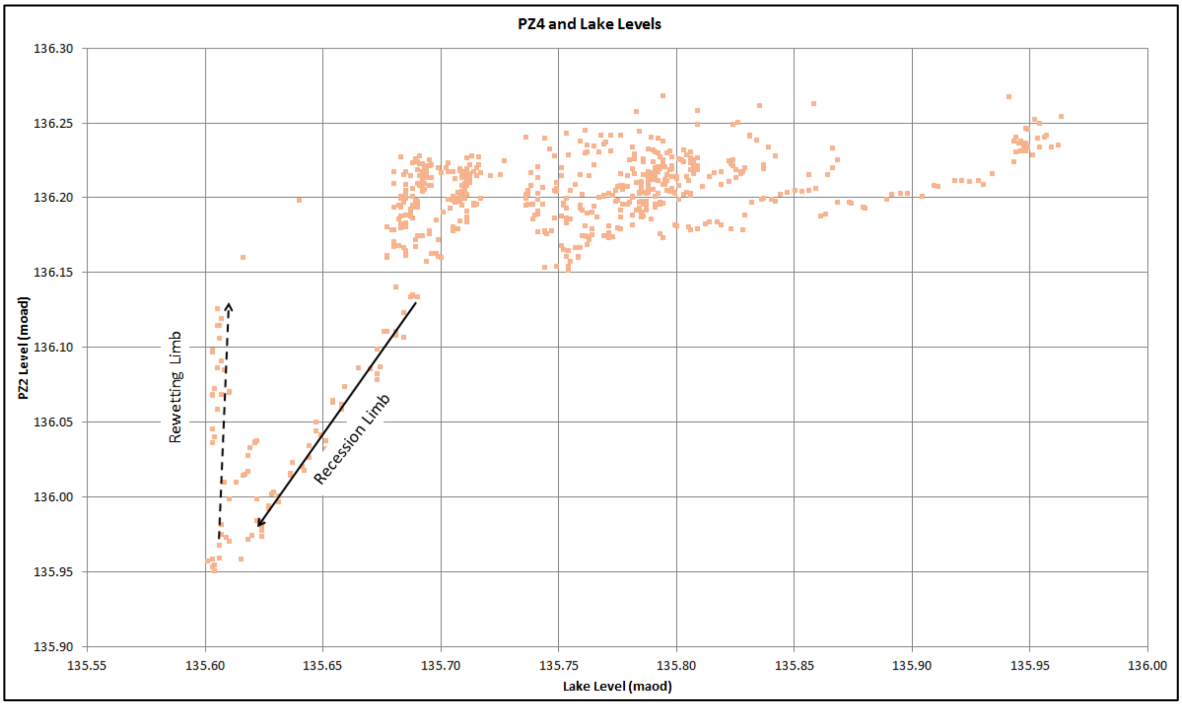


Chart 6.4: PZ5 and Lake Levels

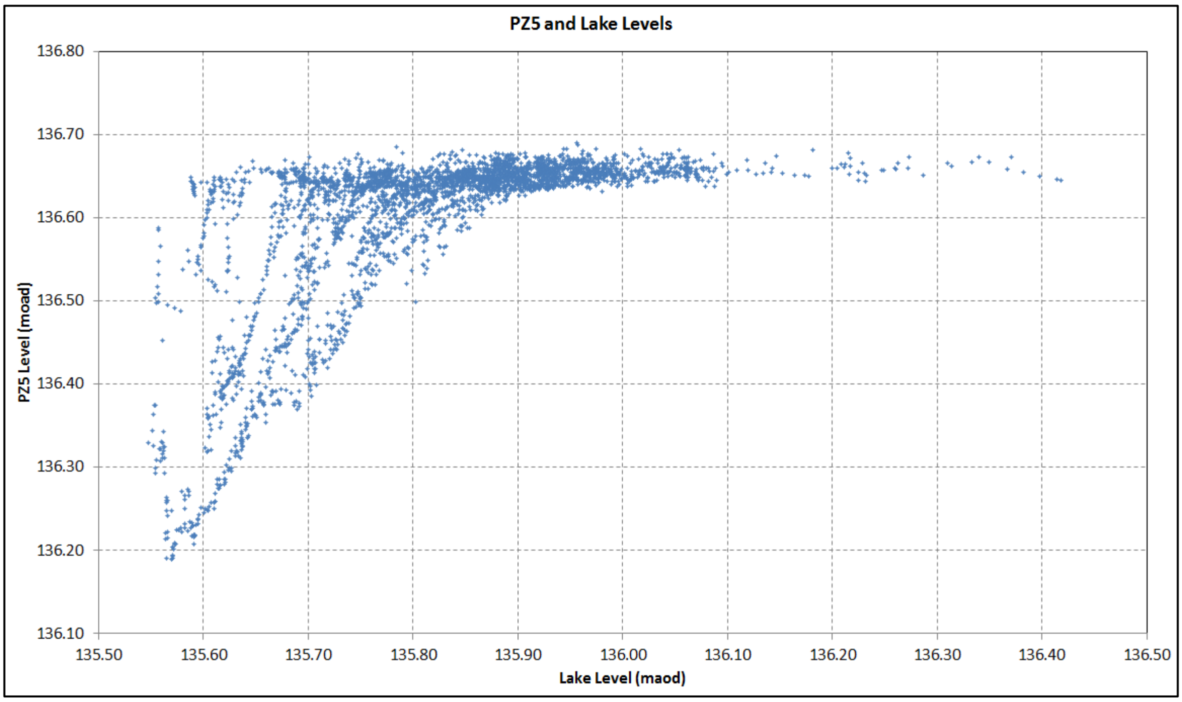
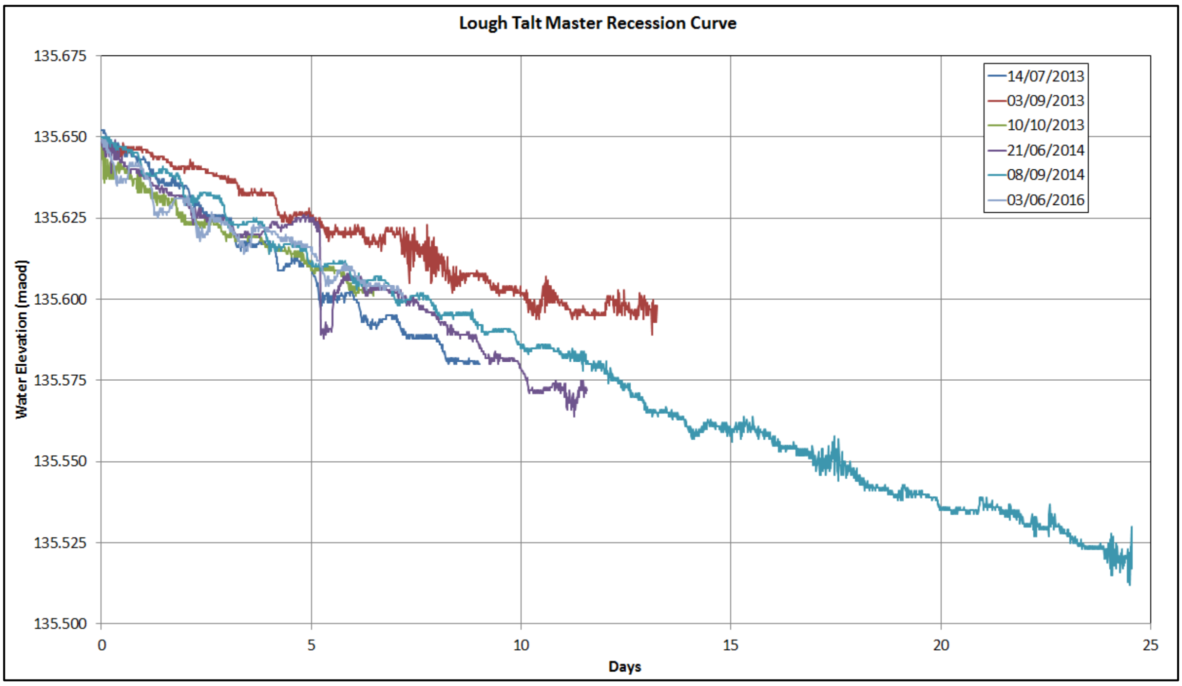


Chart 6.5 presents six extended lake water level recession periods initiating at the 135.65maod water level. The average water level reduction over these recession periods is approximately 5mm/d. This reduction rate is equivalent to a water loss of 5,000m^3/d from the lake, which is approximately two thirds of the current abstraction rate.

This illustrates that the continued lake abstraction at low lake levels draws the lake water level down to elevations below the threshold that correlate with the cessation of supporting habitat conditions within the fen. As such the maintenance of the current abstraction rate during dry weather conditions has an impact on the supporting habitat conditions.

Chart 6.5: Lough Talt Master Recession Curve



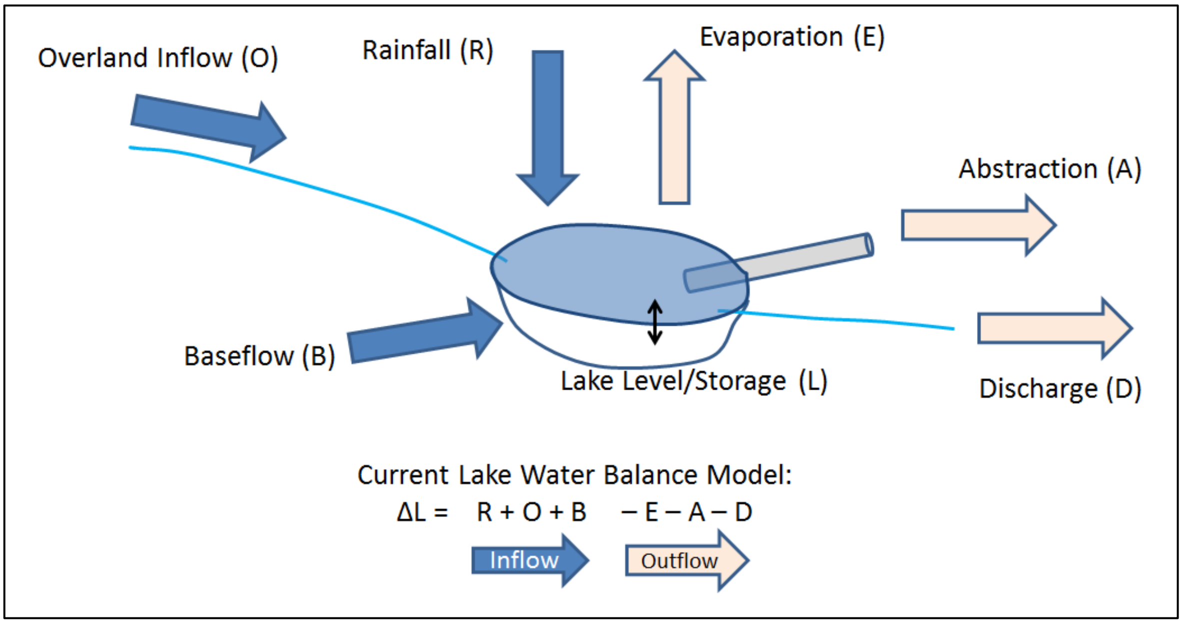
6.4 Proposed Mitigation Measure

The recession curve analysis has shown the lake level recession during dry periods equates to an average water loss of 5,000m^3/d. The water level reduction could therefore be counteracted with a reduction in the abstraction rate by this amount which is approximately two thirds of the current the abstraction rate. However, if the reduction in abstraction rate was to initiate earlier, at a higher lake elevation, then the magnitude of water abstraction rate reduction could be less.

RPS has developed a lake water balance model to assess the optimal lake water abstraction management to maintain the required ecological conditions within the habitat. The lake water balance model is summarised in Chart 6.6. This illustrates that the key components controlling lake level and storage are as follows:

- Inflows:
  - Overland Flow (O) which includes overland distributed flow and small streams flowing into the lake.
  - Baseflow (B) which is groundwater flow to the lake through bedrock and subsoils.
  - Rainfall (R) which is direct rainfall onto the surface of the lake.
- Outflows:
  - Evaporation (E) which is direct evaporation from the lake surface.
  - Discharge (D) which is the overflow from the lake when the lake level is above the culvert.
  - Abstraction (A) is the Lough Talt RWSS abstraction.

Chart 6.6: Lake Modelling Graphic



The lake model is developed to allow the abstraction rate be adjusted and to then predict the resulting lake water level. The abstraction rate is adjusted based on the following two criteria:

- Hands Off Level – Abstraction is ceased when the lake level approaches the level that coincides with the cessation of artesian conditions within the habitat (135.66maod)
- Trigger Level – The level at which abstraction is reduced to 4,000m^3/d. The trigger level can be adjusted to minimise a) the total time that a reduced abstraction rate is required and b) minimise the total time a cessation in abstraction is required. The observed abstraction rate is used in the modelling, which is 7,600m^3/d over the modelled period (01/01/2014 to 07/09/2016).

The model makes the following calculations based on lake water balance based on the hands off and trigger levels selected:

- If the lake water level in the proceeding step is below the trigger level reduce the abstraction to 4,000m^3/d;
    - or if the lake level is below the hands off level cease the abstraction.
- Estimate the higher lake level as a result of the reduced abstraction, and then increase the lake overflow discharge rate based on the rating curve in Chart 4.7.

Charts 6.7, 6.8 and 6.9 show the modelling results for the dry periods in September 2014, June 2016 and for the entire 2014 to current logger data period respectively. The June 2016 period is the driest weather recorded over the period loggers were installed in all six piezometers and the September 2014 period is selected as this represented the driest September on record for the nearest meteorological station (Coolacool) in the available records (since 1952).

For the purposes of these charts the trigger value is set at 135.73maod and the hands off level at 135.66moad. The results of the modelling show how the reduction of abstraction to 4,000m^3/d works to equilibrate the lake drawdown. The results over the 2014 to 2016 also illustrate how the levels return back to “normal” at higher lake elevations as increased overflow discharge rates will cancel out any increased lake levels during dry period once inflows and level increase during wetter periods. Therefore the habitat will not experience additional flooding or high lake levels as a result of the intervention.

Chart 6.7: June 2016 Lake Modelling Results

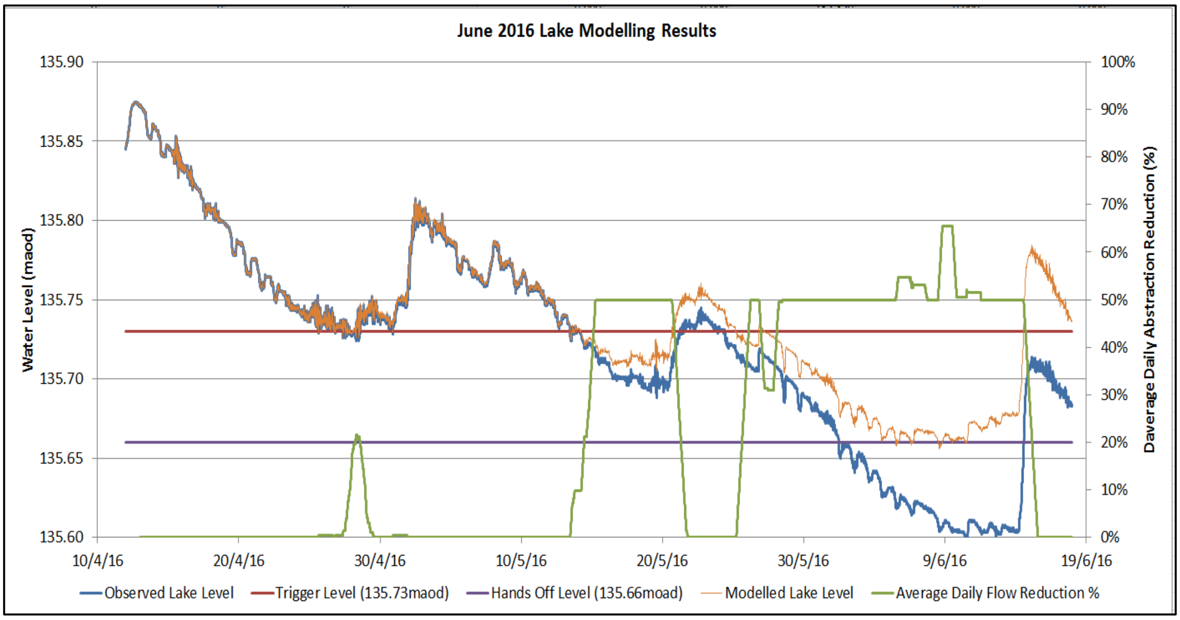


Chart 6.8: Summer & Autumn 2014 Lake Modelling

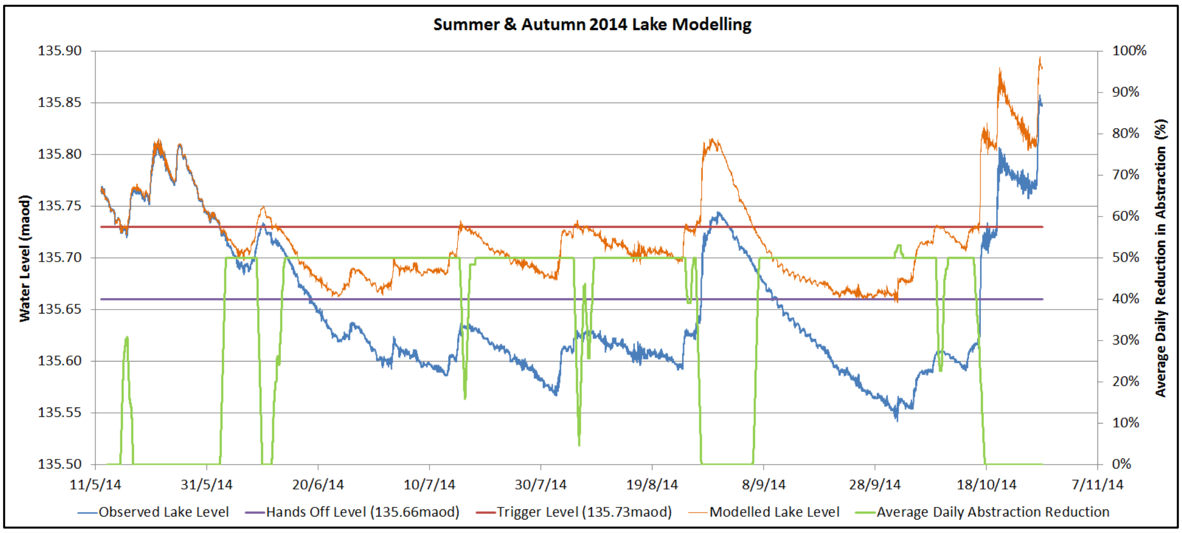


Chart 6.9: 2014 - 2016 Lake Level Modelling Results

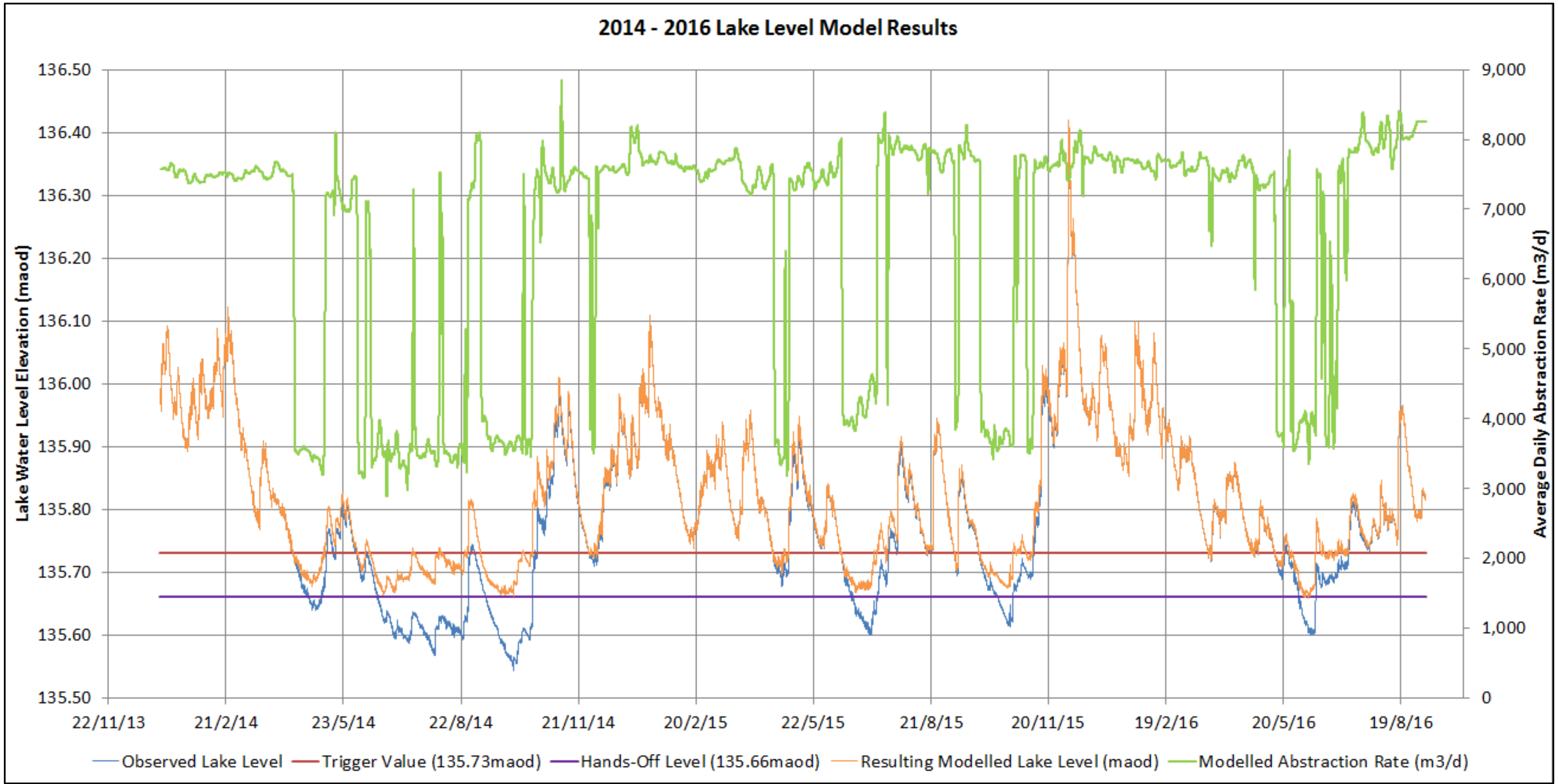
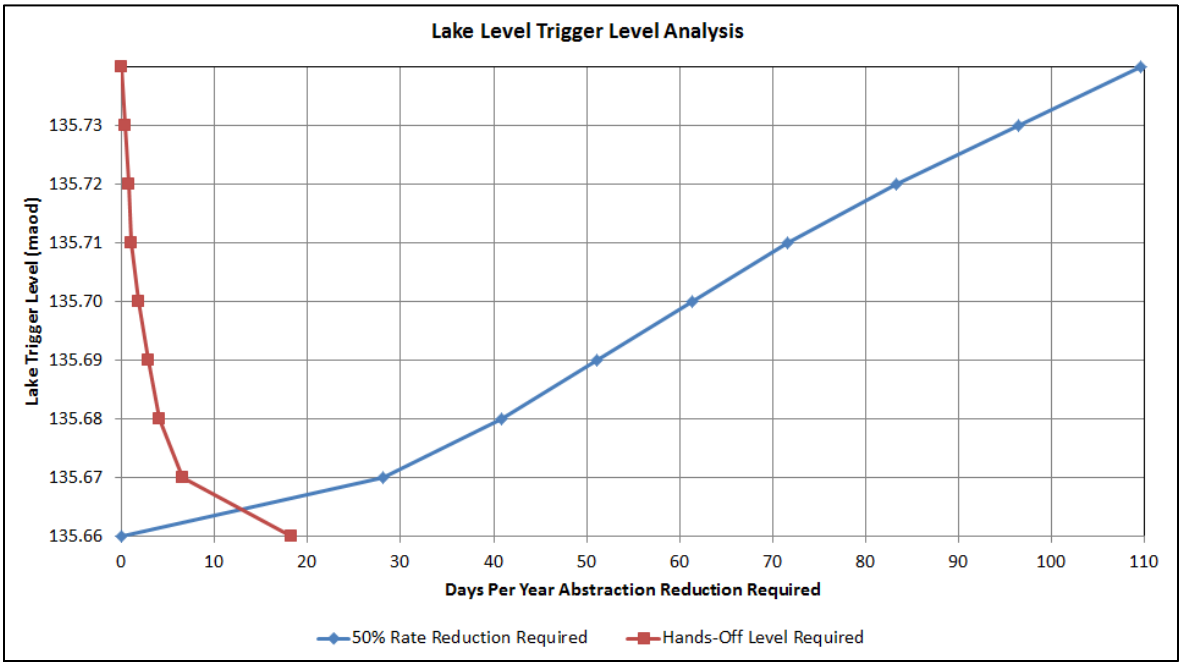


Chart 6.10 presents the results of the modelling where the upper trigger level is adjusted up from being equivalent to the hands-off level (135.66maod), to an upper level where such that the requirement for the hands-off condition is not met. This illustrates the lower the trigger level is set, the more frequently the hands-off level is required. However equally the higher the trigger level is set, the more frequently the reduced abstraction rate is instigated.

The optimised level proposed is for the trigger level to be set at 135.73moad as this is the level above which the hands-off condition is not required over the observed period.

Chart 6.10: Lake Level Trigger Level Analysis



6.5 Conjunctive Use Options

The frequent reduction in water supply to 4,000m^3/d is likely to pose an unacceptable level of water supply service to the consumers and therefore replacement supplies to provide the balance of the demand must be considered.

RPS understands there are some options available for other surface water supplies in the region which are being investigated by RPS and Irish Water.

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7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

RPS has undertaken a hydrogeological investigation at the Vertigo geyeri habitat on the eastern shore of Lough Talt, Co. Sligo. The purpose of the investigation was to assess the linkage between the lake water levels and the groundwater flushes that support the habitat. The results of the assessment were used to determine the potential impact of water abstraction from the lake for human consumption on the Vertigo geyeri habitat.

The site investigation was conducted in May 2013 and comprised the drilling and hydraulic testing of a number of boreholes across the site. Three deep boreholes (BH1d, BH2d and BH3d) were screened in a lower gravel aquifer and two boreholes (BH1s and BH2s) were screened in a shallow till. Six piezometers were installed across the fen area (PZ1 to PZ6). Groundwater level loggers have been installed in all six piezometers and level logger data is available for the lake level and overflow discharge.

The Vertigo geyeri habitat is located in the peat soils of the fen. The site investigation results have shown the habitat is underlain by a gravel aquifer that extends to at least 15m below ground level. The groundwater flow direction is towards the lake and the lake is considered to be in hydraulic continuity with the gravel aquifer.

The gravel aquifer is confined by a thin clay layer close to the lake but is unconfined further up-slope to the north east at BH3d. The presence of the groundwater flushes in the vicinity of the habitat is considered to be a result of artesian conditions in the gravel aquifer where groundwater under pressure discharges diffusely at surface where the confining clay layer is absent.

Monitoring of the piezometers within the habitat area shows the groundwater head in the shallow peat soils drops below ground during extended dry periods, when the head in the underlying gravel aquifer drops below ground level it no longer supports the surface groundwater discharges and the habitat requirements for the snail.

Analysis of the head distributions throughout the gravel aquifer have shown that these are directly controlled by the lake level during dry conditions when any influence of direct precipitation is absent. When the lake level drops during a recession period this propagates a drop in the groundwater levels back through the gravel aquifer.

Analysis of the logger data has shown the cessation of artesian conditions occurs at PZ2, PZ3 and PZ4 when the lake level drops below 135.66maod. The current lake abstraction operation results in the lake level dropping below this level on an annual basis during dry weather. The continued abstraction from the lake when the water level drops below this elevation has an impact on the artesian conditions within the fen, which are the supporting conditions for the habitat.

RPS have developed a lake water balance model which assess the influence of lake water levels of instigating a trigger level at which point the lake abstraction is reduced to 4,000m^3/d and that abstraction is ceased entirely if the lake continues to drop below the hands off level.

The modelling has shown a number of scenarios exist for the successful management of the lake water levels depending on how frequently a complete cessation of abstraction or the reduction to 4,000m^3/d is possible. Where a trigger level of 135.73moad is selected this results in virtually no instances where the hands off level are exceeded and the requirement for reduced abstraction is required on average 95 days a year.

If the modelled reduction in abstraction rate is applied then the potential impact of the proposed development is estimated to be slight to negligible and may in fact have a slight beneficial impact as it could lead to an increased area of optimal habitat within the fen.

7.2 Recommendations

An alternative water supply source will be required to supplement the supply where the abstraction is reduced to 4,000m^3/d. RPS understands there are some options for alternative water supplies which are being further assessed by RPS and Irish Water.

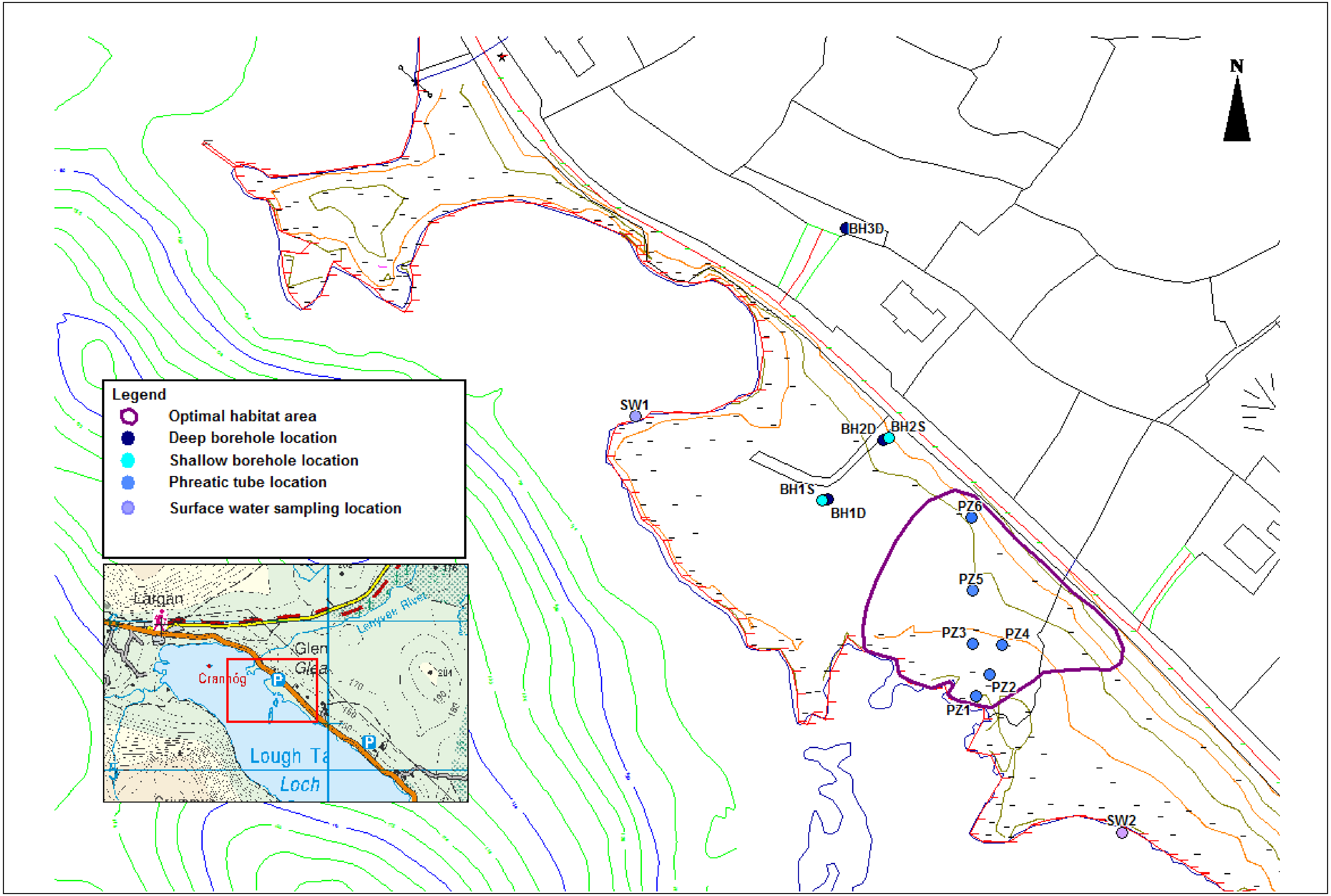
RPS recommends that groundwater monitoring at Lough Talt is continued for the foreseeable future. RPS recommends that biannual site visits are completed by a hydrogeologist to download the level loggers, manually record the groundwater levels to allow for logger calibration.

7.3 References

Evelyn Moorken & Associates (2016) *Assessment of Vertigo Geyeri Habitat at Lough Talt, Co. Sligo with Reference to the Integration of Microtropography and Microhabitats Condition to integrate with Hydrological Monitoring.* Unpublished Consultants Report.

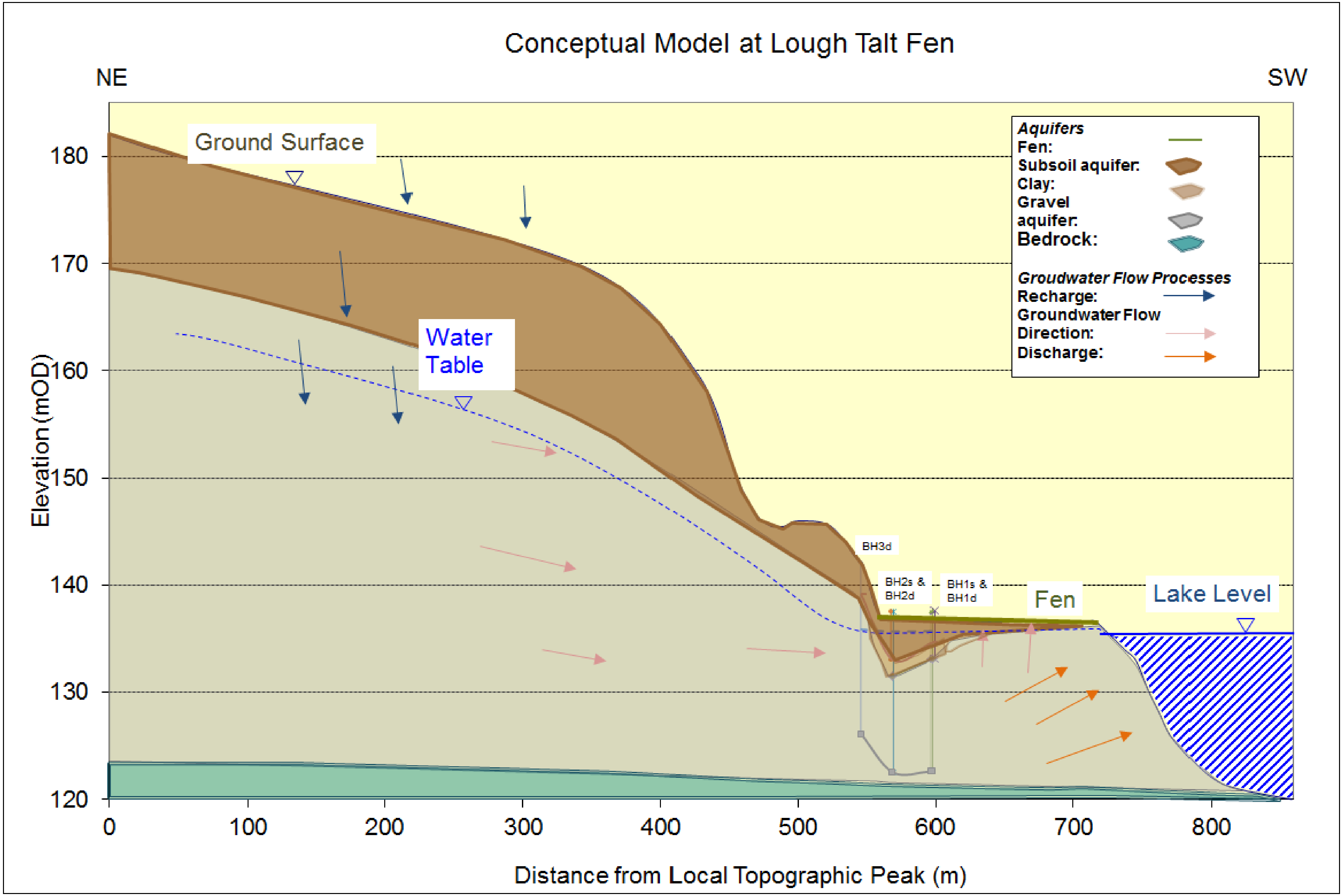
RPS (2013) *Lough Talt Hydrogeological Impact Assessment Report (RPS Ref No.i143/D1/003a)* Unpublished Consultants Report to Sligo Co.Co.

FIGURES



RPS Aquaterra

LOUGH TALT MONITORING LOCATIONS FIGURE 1.1



RPS Aquaterra

CONCEPTUAL SITE MODEL FIGURE 2.1

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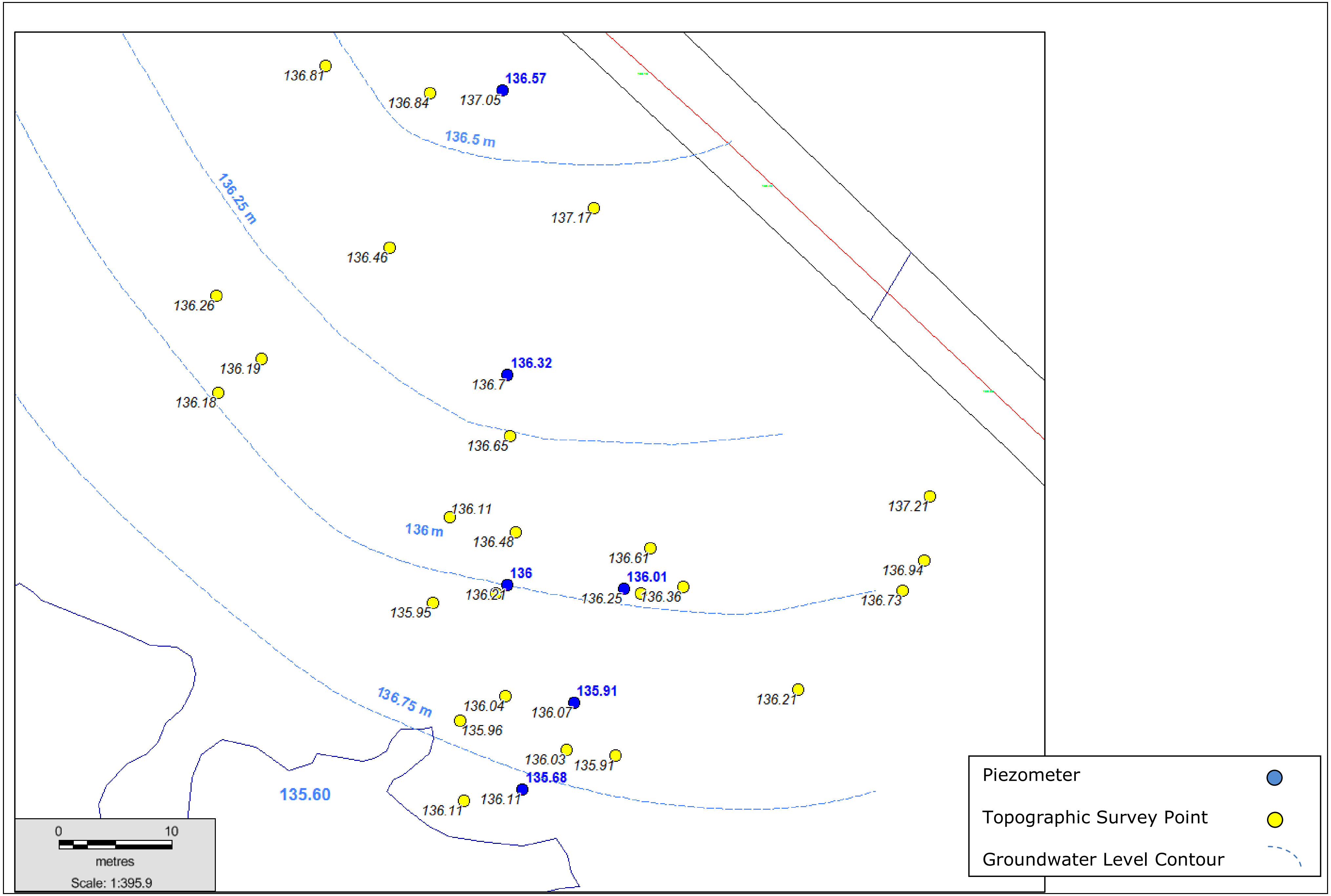


RPS Aquaterra

LOUGH TALT GROUND ELEVATION AND WATER LEVEL 10TH JUNE 2016 FIGURE 4.1

APPENDIX E – HABITAT DETAILS AND IMAGES

The habitats found in the environs of Lough Talt are listed in the table below

Table 1 Habitats surrounding in Lough Talt

HABITATS	CODE	LINKS TO ANNEX I HABITATS
Freshwater		
Mesotrophic lakes	FL4	Potential linkages with the Annex I habitat 3140 'Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (3140)'
Eroding/upland rivers	FW1	N/A
Grassland		
Improved Agricultural Grassland	GA1	N/A
Dry Neutral Calcareous Grassland	GS1	N/A
Dry Humid Acid Grassland	GS3	N/A
Wet Grassland	GS4	N/A
Heath and Dense Bracken		
Wet Heath	HH3	4010 Northern Atlantic wet heaths with Erica tetralix
Dense Bracken	HD1	N/A
Peatlands		
Cutover Bog	PB4	7150 Depressions on peat substrates of the Rhynchosporion can occur in pockets on Cutover Bog
Rich Fen and Flush	PF1	^^7230 Alkaline Fens
Woodland and Scrub		
Wet Willow Alder Ash Woodland	WN6	N/A
Scrub	WS1	N/A

^Qualifying Habitats of Lough Hoe Bog SAC
^^Habitats Supports Annex II Species

Mesotrophic Lakes (FL4)

Lough Talt is a freshwater lake and is classified as a Mesotrophic Lake FL4. The emergent vegetation found along the Lough shore includes small pockets of Reed and Large Sedge Swamp FS1 with species such as Common Reed (*Phragmites australis*) and Bulrush (*Schoenoplectus lacustris*). Other species found growing in the Lough include Mint (*Mentha aquatica*), Shoreweed (*Littorella uniflora*), Broad-leaved Pondweed (*Potamogeton natans*), Water Horsetail (*Equisetum fluviatile*) and Spike Rush (*Eleocharis multicaulis*). The shores and margins of the lakes support a variety to habitats including Rich Fen and Flush PF1, Wet Grassland GS4, Marsh GM1 and Wet Heath (HH3).

Species including Alternate Water-milfoil (*Myriophyllum alterniflorum),* Stonewort (*Nitella sp.) and* Shoreweed *Littorella uniflora* are characteristic species of the 3110 Annex I habitat, however the Site Specific conservation objectives supporting document for Lough Hoe Bog SAC provides the following commentary for Lough Talt: *Lake habitat 3110 is likely to occur in larger upland lakes in the SAC, such as Loughs Hoe, Alone, Fossea and Nalackagh. The exact distribution of 3110 is unknown, as no specific information on lake vegetation is available. Habitat 3110 may co-occur with lake habitat 3160 in upland lakes, which is also likely to occur in smaller lakes and ponds. There are also* *calcareous influences- Lough Talt has marginal calcareous springs and may be dominated by lake habitat 3140.*

Ecological Interest	Links to Annex I Habitats
International Importance	Potential linkages with the Annex I habitat 3140 'Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (3140)'

Eroding Upland River (FW1)

Lough Talt is drained by the Eighnagh River, which is a small fast flowing stream which flows in a south westerly direction from the south of Lough Talt. The Eighnagh River is designated under the River Moy SAC. This river is typical of eroding upland rivers with little or no deposition of fine sediment and relatively fast, turbulent flow. The bed of the streams is characterised by exposed bedrock and loose cobbles. During the site walkover survey the channels water width exceeded 3.0 m in parts with water depths measuring up to 1.0 m. It supports little or no emergent aquatic macrophyte growth. The River is fringed by degraded peatland and semi-improved, poor draining grassland and pockets of scrub with Willow (*Salix* spp), Ash (*Fraxinus excelsior*) and Gorse (*Ulex Europaeus*), with Heath Bedstraw (*Galium saxatile*), Wild Angelica (*Angelica sylvestris*) and Slender St. John's-wort (*Hypericum pulchrum*) in the understory.

The Eighnagh River provides suitable habitat for a number of Annex II species including Atlantic Salmon (*Salmo salar*), Brook Lamprey (*Lampetra planeri*) and White-clawed Crayfish (*Austropotamobius pallipes*). Freshwater Pearl Mussel (*Margaritifera margaritifera*) has been recorded in lower reaches of the Eighnagh River and Otter (*Lutra lutra*) are found throughout the catchment. Stream corridors can also provide valuable foraging habitat for local bat populations. The conservation objectives of the River Moy SAC and Lough Hoe Bog SAC are to maintain the favourable conservation status of the Annex I Habitats and Annex II species. All species which are found within these lacustrine and river systems depend on high water quality standards for their conservation.

Ecological Interest	Links to Annex I Habitats
International Importance	May support Annex I habitat - Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation (not found within the stretches of watercourses within the study area). Also supports a number of Annex II species.

Improved Agricultural Grassland GA1

Improved Agricultural Grassland GA1 is found throughout the landscape surrounding Lough Talt. Small fields have been agriculturally improved particularly on the western shores. This habitat type comprises primarily a grassy sward of typical agricultural grassland cultivars, including a dominance of Perennial Rye-grass (*Lolium perenne*) with Cock's-foot (*Dactylis glomerata*), Fescues (*Festuca* spp.), Yorkshire Fog (*Holcus lanatus*) and Meadow species (*Poa* spp.) occurring, particularly in the field margins.

The herbs, Ribwort Plantain (*Plantago lanceolata*), White Clover (*Trifolium pratense)* and Daisy (*Bellis perennis*) occur abundantly. Herbs occurring less frequently include Thistles (*Cirsium* sp.), Dandelion (*Taraxacum* sp.), Creeping Cinquefoil (*Potentilla reptans*), Silverweed (*Potentilla anserina*), Chickweed (*Cerastium glomeratum*), Common mouse-ear (*Cerastium fontanum*) and Common Nettle (*Urtica dioica*).

Ecological Interest	Links to Annex I Habitats
Local Importance (Lower Value)	Improved grasslands are not linked to Annex I habitats. They may offer some foraging potential for local mammals such as badger and hare.

Dry Neutral and Calcareous Grassland GS1

Small areas of Dry Neutral and Calcareous Grassland GS1 can be found in road verges, dry banks and peninsulas which jut out from the northern shore into the lake. Species such Quaking Grass (*Briza media*) and Kidney Vetch (*Anthyllis vulneraria*) are indicators of calcareous grasslands. The species list is provided in **Appendix E**.

The *Irish semi-natural grasslands survey 2007-2012* (O'Neil, et. al. 2013) outlines the criteria used to assess Annex I grassland habitats, in that at seven least indicator species are required to be classified as the Annex I Habitat Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (6210) and any uncommon orchid species recorded in this Annex I habitat should be considered the Annex I Priority Habitat (*6210 important orchid sites). Cumulatively, nine indicator species were recorded in the grassland to the north of Lough Talt, comprising three positive indicator species *Carex flacca, Daucus carota,* and *Lotus corniculatus,* four high quality positive indicator species including *Anthyllis vulneraria, Antennaria dioica Filipendula ulmaria,* and *Briza media,* and two orchid species including *Dactylorhiza fuchsii* and *Listera ovata*. Therefore, the habitat corresponds to the Annex I Priority habitat 6210.

This habitat is not a qualifying interest of Lough Hoe Bog SAC, however, although the areas are small in extent they are quite species rich and of ecological importance.

Ecological Interest	Links to Annex I Habitats
County Importance	This habitat corresponds to the Annex I Priority habitat Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) important orchid sites (6210).

Species Recorded in Dry Neutral and Calcareous Grassland GS1 Habitat

Species (*Latin* name)	Species (common name)
Agrostis stolonifera	Creeping Bent
Alopecurus pratensis	Meadow Foxtail
Antennaria dioica	Mountain Everlasting
Anthyllis vulneraria	Kidney Vetch
Arrhenatherum elatius	False Oat-grass
Bellis perennis	Daisy
Briza media	Quaking Grass
Calluna vulgaris	Ling Heather
Carex flacca	Glaucous Sedge
Carex panicea	Carnation Sedge
Carex rostrata	Bottle Sedge
Cynosurus cristatus	Crested Dog's-tail
Dactylorhiza fuchsii	Common Spotted Orchid
Daucus carota	Wild Carrot
Equisetum palustre	Marsh Horsetail
Festuca ovina	Sheep's Fescue
Filipendula ulmaria	Meadowsweet

Species (*Latin* name)	Species (common name)
Glyceria declinata	Small Sweet-grass
Hypochaeris radicata	Cats ear
Hydrocotyle vulgaris	Marsh Pennywort
Iris pseudacorus	Yellow Iris
Lathyrus pratensis	Meadow Vetchling
Leucanthemum vulgare	Oxeye Daisy
Listera ovata	Common Twayblade
Lotus corniculatus	Common Bird's-foot-trefoil
Luzula multiflora	Heath Wood-rush
Lychnis flos-cuculi	Ragged Robin
Medicago lupulina	Black Medick
Mentha aquatica	Mint
Phleum pratense	Timothy grass
Potamogeton natans	Broad-leaved Pondweed
Potentilla anserina	Silverweed
Ranunculus acris	Meadow Buttercup
Senecio jacobea	Common Ragwort
Trifolium pratense	Red Clover
Tussilago farfara	Colt's-foot
Vaccinium myrtillus	Bilberry

Dry Humid Acid Grassland (GS3)

This habitat type occurs on shallow free draining soils on the steeper slopes of the site; forming intimate mosaics with Wet Heath HH3. This habitat is characterised by a short sward with tussocks of Matt Grass (*Nardus stricta*) prevailing. This habitat is degraded in areas as a result of heavy poaching by grazing sheep. The habitat exhibits a good species diversity of vascular plants, herbs, mosses and a scattering of shrubs including Gorse and Heather (*Calluna vulgaris*).

From the *Status of EU Protected Habitats and Species in Ireland* (NPWS, 2013), Species-rich *Nardus* grasslands on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) (6230) Conservation Status Assessment Report, '*Species-rich Nardus grasslands are predominantly found on acidic soils on sloping ground in upland areas of Ireland. They generally occur in a narrow band between 200-400m in elevation'*. To qualify as the Annex I habitat the sward should have a relatively high cover of broadleaved herbs and high species diversity (≥ 25 species). Dwyer *et al.* (2007) developed a list of twenty-one species which include the species listed in the EU Interpretation Manual for species-rich *Nardus* grassland, which are deemed to be indicative of this grassland type in the Irish context, in the NSUH (Perrin et al 2014), at seven least indicator species are required to be classified as the Annex I Habitat. Five of these positive indicator species are found within Acid Grassland habitats within the study area, including *Galium saxatile, Nardus stricta, Potentilla erecta, Prunella vulgaris and Rhytidiadelphus loreus.* Therefore, the habitat does not correspond to the Annex Habitat type.

The acid grasslands found within the study area correspond to the *Nardus stricta*, *Galium saxatile* Upland Grassland sub community UG2a.

Ecological Interest	Links to Annex I Habitats
Local Importance (Higher (Value)	This habitat is not linked to Annex I Habitats, Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe) (*6230) but the grasslands do support diversity of botanical species.

Species Recorded in Dry Humid Acid Grassland GS3 Habitat

Species (*Latin* name)	Species (common name)
Agrostis spp.	Bent grass
Blechnum spicant	Hard Fern
Brachythecium rutabulum	Moss
Calluna vulgaris	Ling Heather
Campylopus introflexus	Heath Star Moss
Carex spp.	Sedge
Cladonia sp.	Lichen
Corylus avellana	Hazel
Crataegus monogyna	Hawthorn
Deschampsia flexuosa	Wavy Hair Grass
Erica cinerea	Bell Heather
Eriophorum vaginatum	Hare's Tail Cotton Grass
Festuca spp.	Fescue Grasses
Galium saxatile	Heath Bedstraw
Juncus effusus	Soft Rush
Juncus inflexus	Hard Rush
Juncus squarrosus	Heath Rush
Molinia caerulea	Purple moor grass
Nardus stricta	Matt Grass
Pedicularis sylvatica	Lousewort
Pleurozium schreberi	Red-stemmed Feather Moss
Polytrichum commune	Common Haircap Moss
Potentilla erecta	Tormentil
Prunella vulgaris	Self Heal
Pteridium aquilinum	Bracken
Rumex acetosella	Sheep's Sorrel
Rhytidiadelphus loreus	Little Shaggy Moss
Salix aurita	Eared Willow
Succisa pratensis	Devil's-bit Scabious
Trifolium repens	White Clover
Trichophorum cespitosum	Deer Grass
Vaccinium myrtillus	Billberry

Wet Grassland (GS4)

This habitat occurs throughout the site, generally on the lower slopes, lake margins and on the banks of the Eighnagh River where grasslands that have had little agricultural improvement. This habitat is characterised by Rushes, Sedges *(Carex spp),* grasses including Yorkshire Fog (*Holcus lanatus*), Sweet Vernal Grass (*Anthoxanthum odoratum*), and broadleaved herbs including Tormentil (*Potentilla erecta*), White Clover, Sheep's Sorrel (*Rumex acetosella*) and Yellow Rattle (*Rhinanthus minor*). The wetter areas support Butterwort (*Pinguicula vulgaris*), Heath Wood-rush (*Luzula multiflora*), and Marsh Lousewort (*Pedicularis palustris*), whilst Bog mosses (*Sphagnum spp*.) can be found in the damp hollows throughout. This habitat often forms mosaics with Wet Heath HH3 and Cutover Bog PB4 habitat. The species list is provided in **Appendix E**.

There are two grassland communities referable to the GS4 classification discussed in the NSUH (Perrin et al 2014), UG4 and PFLU3.

The PFLU3 *Juncus acutiflorus/effusus - Calliergonella cuspidata* community is a non-peat forming flush habitat dominated by rushes *Juncus effusus* or Juncus acutiflorus, *Juncus effusus* and *Molinia caerulea* and pleurocarpous mosses such as *Hylocomium splendens*. Other typical species include *Rumex acetosa, Calliergonella cuspidata* and *Holcus lanatus.*

The second community of UG4 which may be derived from degraded bog or overgrazed wet heath habitats. This habitat is characterised by Purple Moor-grass (*Molinia caerulea*), Sweet Vernal Grass (*Anthoxanthum odoratum)*, Mat-grass (*Nardus stricta)* fescues (*Festuca* spp), Tormentil (*Potentilla erecta*), Devil's-bit Scabious (*Succisa pratensis*) and Heath Milkwort (*Polygala serpyllifolia*). This habitat often forms mosaics with wet heath and improved grasslands.

The wet grassland habitat found within the study area support the UG4 vegetation community and does not correspond to Annex I Habitat.

Ecological Interest	Links to Annex I Habitats
Local Importance (Higher (Value)	The Wet Grassland habitats found within the site do not correspond to the EU Habitats Directive Annex I Habitat: '*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)' (6410).

Species Recorded in Wet Grassland GS4 Habitat

Species (*Latin* name)	Species (common name)
Agrostis spp.	Bent grass
Anthoxanthum odoratum	Sweet vernal Grass
Blechnum spicant	Hard Fern
Calluna vulgaris	Ling Heather
Cardamine pratensis	Cuckoo Flower
Carex panicea	Carnation Sedge
Carex nigra	Black Sedge
Deschampsia flexuosa	Wavy Hair Grass
Festuca spp.	Fescue Grasses
Holcus lanatus	Yorkshire Fog
Juncus conglomeratus	Compact Rush
Juncus effusus	Soft Rush
Juncus inflexus	Hard Rush
Luzula multiflora	Heath Wood-rush
Molinia caerulea	Purple moor grass
Nardus stricta	Matt Grass
Pedicularis sylvatica	Lousewort
Pinguicula vulgaris	Butterwort
Potentilla erecta	Tormentil
Pteridium aquilinum	Bracken
Ranunculus repens	Creeping buttercup
Rhytidiadelphus loreus	Spring Turf Moss
Rhinanthus minor	Yellow Rattle
Rumex acetosella	Sheep's Sorrel
Sphagnum spp.	Sphagnum moss
Succisa pratensis	Devil's-bit Scabious
Trifolium repens	White Clover

Wet Heath (HH3)

Wet Heath HH3 can be found at several locations around the lake, often forming mosaic with other habitat types; including Wet Grassland GS4 and Cutover Bog PB4. Wet Heath vegetation typically occurs on shallow peat, generally under 0.5 metres in depth. The Wet Heath species include Ling Heather (*Calluna vulgaris*) and Crossed-leaved Heath (*Erica tetralix*), Bilberry (*Vaccinium myrtillus*), Purple Moor-grass (*Molinia caerulea*) and Cotton grass (*Eriophorum vaginatum*). Mosses such as *Rhytidiadelphus squarrosus, Pleurozium schreberi* and *Polytrichum commune* are common, with Sphagnum species and Star Sedge (*Carex echinata)* occurring in the flushed areas. The species list is provided in **Appendix E**.

There are four provisional dry heath communities referable to the HH3 classification as outlined in the Draft *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland* (Perrin et al 2012), WH1, WH3, WH4 and WH6.

The wet heath habitat found within the study area support the WH3 heath vegetation community *Calluna vulgaris - Molinia caerulea - Sphagnum capillifolium* wet/damp heath which is characterised by the dominance of *Calluna vulgaris, Molinia caerulea* and *Sphagnum capillifolium; Molinia caerulea.* This habitat corresponds to the Annex I Habitat Northern Atlantic wet heaths with *Erica tetralix* (4010). This habitat is not a qualifying interest of Lough Hoe Bog SAC.

Species Recorded in Wet Heath HH3 Habitat

Species (*Latin* name)	Species (common name)
Calluna vulgaris	Ling Heather
Carex echinata	Star Sedge
Carex flacca	Glaucous Sedge
Cladonia sp.	Lichen
Erica cinerea	Bell Heather
Erica tetralix	Cross-leaved Heath
Eriophorum vaginatum	Hare's Tail Cotton Grass
Juncus effusus	Soft Rush
Juncus inflexus	Hard Rush
Juncus squarrosus	Heath Rush
Hylocomium splendens	Moss
Molinia caerulea	Purple moor grass
Narthecium ossifragum	Bog Asphodel
Pleurozium schreberi	Red-stemmed Feather Moss
Polygala serpyllifolia	Heath Milkwort
Polytrichum commune	Common Haircap Moss
Potentilla erecta	Tormentil
Pteridium aquilinum	Bracken
Rhytidiadelphus loreus	Spring Turf Moss
Sphagnum spp.	Sphagnum moss
Succisa pratensis	Devil's bit Scabious
Trichophorum cespitosum	Deer Grass
Vaccinium myrtillus	Billberry

Dense Bracken (HD1)

Large areas of Bracken (*Pteridium aquilinum*) dominated vegetation can be found on the steep slopes to the west of Lough Talt. On the eastern shores of the lake, there are areas of Scrub WS1, Fen PF1 and Wet Willow Alder Ash Woodland WN6 which are being invaded by Bracken. Dense Bracken is of little ecological value, however is can provide some shelter and foraging habitat for species of bird and small mammal.

Ecological Interest	Links to Annex I Habitats
Local Importance (Lower Value)	This habitat does not correspond to EU Habitats Directive Annex 1 Habitats. Bracken can be invasive and is considered to be of low conservation value.

Cutover Bog (PB4)

There is a small area of Cutover Bog on the northern shores of Lough Talt. Turf banks indicate a history of peat extraction at the site. The areas of modified Upland Blanket Bog habitat PB2, that have been cut have re-vegetated with varying assemblages of species, depending on hydrology, depth of peat remaining, nature of the peat and underlying substratum. Typical species include; Purple Moor Grass (*Molinia caerulea)*, Wavy Hair-Grass (*Deschampsia flexuosa*), Bog Asphodel *(Narthecium ossifragum)*, Common Cottongrass (*Eriophorum angustifolium)*, Ling Heather *(Calluna vulgaris)* and some Gorse scrub. The peat banks as a result of natural succession have been colonised with Wet Heath vegetation. However, the wetter hollows are usually dominated by Deer Grass *(Trichophorum cespitosum),* Bog Cotton Grasses and Bog Asphodel (*Narthecium ossifragum)*. The S*phagnum* species occur throughout.

The wet heath vegetation corresponds to the Annex 1 habitat 'Northern Atlantic wet heaths with Erica tetralix (4010)'and the vegetation communities supported in flooded cutover areas and hollows corresponds to the annexed habitat 'depressions on peat substrates of the *Rhynchosporion* (7150)'. The species list is provided in **Appendix E**.

Ecological Interest	Links to Annex I Habitats
County Importance	EU Habitats Directive Annex 1 Habitats: Northern Atlantic wet heaths with Erica tetralix (4010) and 'Depressions on peat substrates of the *Rhynchosporion* (7150)' can occur in pockets on Cutover Bog.

Species Recorded in Cutover Bog PB4 Habitat

Species (*Latin* name)	Species (common name)
Calluna vulgaris	Ling Heather
Carex spp.	Sedge species
Cladonia sp.	Lichen
Erica cinerea	Bell Heather
Erica tetralix	Cross-leaved Heath
Eriophorum angustifolium	Common Bog Cotton
Eriophorum vaginatum	Hare's Tail Cotton Grass
Juncus effusus	Soft Rush
Juncus inflexus	Hard Rush
Juncus squarrosus	Heath Rush
Molinia caerulea	Purple moor grass
Narthecium ossifragum	Bog Asphodel

Species (*Latin* name)	Species (common name)
Potentilla erecta	Tormentil
Sphagnum spp.	Sphagnum moss
Succisa pratensis	Devil's bit Scabious
Trichophorum cespitosum	Deer Grass
Vaccinium myrtillus	Billberry

Rich Fen and Flush PF1

Small areas of Rich Fen and Flush PF1 vegetation were recorded to the northwest of Lough Talt. Sedge flushes also occur on the lower slopes of Crummus Hill on the lake shore, which show a strong calcareous influence. The area contains abundant Common Butterwort *(Pinguicula vulgaris*), Hare's-tail Cottongrass (*Eriophorum vaginatum),* Sharp-flowered Rush (*Juncus acutiflorus/articulatus)*, Carnation Sedge *(Carex panacea)*, Star Sedge *(Carex echinata)*, Black Sedge *(Carex nigra*), Common Yellow Sedge (*Carex demissa*), White Beak Sedge (*Rhynchospora alba*), and the lichen (*Cladonia* spp).

The fen, historically supported a population of Geyer's whorl snail (*Vertigo geyeri)*, which was first recorded at Lough Talt in 1992 and was last recorded at the site in 2007. The species was recorded in the north east fen-marsh lake shore spring-seepage slopes, with sedge-rich, mossy seepage zones in open situations. *Vertigo geyeri* is a Qualifying Species of Lough Hoe Bog cSAC. The botanical species found within this habitat include includes Common Butterwort *(Pinguicula vulgaris*), Grass of Parnassus *(Parnassia palustris),* Devils-bit Scabious (*Succisa pratensis),* Sedge species*,* Horsetail *(Equisetum palustris),* Yorkshire Fog *(Holcus lanatus),* Quaking Grass *(Briza media)* and moss (*Drepanocladus revolvens).*

The specific areas that support *V. geyeri* are within a wider mosaic of heather hummocks and denser vegetation, and are specific to emergent seepages, where they typically fit the characteristic vegetation classification within the *Caricion davallianae* alliance, characteristically being distinguished by *Carex viridula, Parnassia palustris, Campylium stellatum, Drepanocladus revolvens, Orchis mascula, Eleocharis quinqueflora, Pinguicula vulgaris, Carex panicea, Schoenus nigricans, Briza media, Succisa pratensis, Equisetum palustris, Mentha aquatica, Hydrocotyle vulgaris, and Menyanthes trifoliata* (Rodwell, 1991).

The Rich Fen and Flush PF1 habitat corresponds to the Annex I Alkaline fens (7230). Alkaline Fens are not a qualifying habitat of Lough Hoe Bog SAC; however the habitat is of ecological significance, not only for the botanical diversity it supports but also the rich assemblage of invertebrates, including Annex II species, *V. geyeri,* a qualifying interest of Lough Bog SAC; however the species has not been recorded at Lough Talt since 2007.

Ecological Interest	Links to Annex I Habitats
International Importance	EU Habitats Directive Annex 1 Habitats: Annex I Habitat 'Alkaline Fen (7230)'

Species Recorded in Rich Fen and Flush PF1 Habitat

Species (Latin name)	**Species (common name)**
Angelica sylvestris	Angelica
Anthoxanthum odoratum	Sweet Vernal Grass
Briza media	Quaking Grass
Caltha palustris	Marsh-marigold
Carex demissa	Common Yellow Sedge
Carex echinata	Star Sedge
Carex flacca	Glaucous sedge
Carex nigra	Black Sedge
Carex panicea	Carnation Sedge
Carex viridula ssp. brachyrrhyncha	Long-stalked Yellow-sedge
Cirsium dissectum	Meadow Thistle
Cirsium palustre	Marsh Thistle
Cynosurus cristatus	Crested Dog's-tail
Drepanocladus revolvens	Moss
Eriophorum vaginatum	Hare's-tail Cottongrass
Equisetum palustris	Horsetail
Festuca rubra	Red Fescue
Filipendula ulmaria	Meadowsweet
Holcus lanatus	Yorkshire Fog
Hydrocotyle vulgaris	Marsh Pennywort
Juncus acutiflorus/articulatus	Sharp-flowered/Jointed Rush
Juncus conglomeratus	Compact Rush
Lathyrus pratensis	Meadow Vetchling
Lythrum salicaria	Purple Loosestrife
Mentha sp.	Mint
Menyanthes trifoliata	Bog Bean
Molinia caerulea	Purple Moor Grass
Parnassus palustris	Grass of Parnassus
Pedicularis palustris	Marsh Lousewort
Pinguicula vulgaris	Common Butterwort
Potentilla erecta	Tormentil
Ranunculus acris	Meadow Buttercup
Ranunculus flammula	Lesser Spearwort
Rhynchospora alba	White Beak Sedge
Rorippa nasturtium-aquaticum	Water-cress
Succisa pratensis	Devils-bit Scabious
Trifolium pratense	Red Clover
Vicia cracca	Tufted Vetch

Wet Willow Alder Ash Woodland WN6

Small areas of this habitat type can be found to the north and east of Lough Talt and on the islands within the lake. Common Gulls (*Larus canus*) nest on the island and Black-headed Gulls (*Larus ridibundus*) are also reported to use the island for nesting.

This woodland type is dominated by Willows (*Salix* spp.) and Ash (*Fraxinus excelsior*), with occasional Alder (*Alnus glutinosa*), Rowan (*Sorbus aucuparia*) and Hawthorn (*Crataegus monogyna*). The ground layer is very dense, dominated by Bramble (*Rubus fruticosus agg.*), with abundant Meadowsweet (*Filipendula ulmaria*) and occasional Herb Robert (*Geranium robertianum*) and ferns such as Male Fern (*Dryopteris filix-mas*), which indicates that this woodland and other examples found within the ZOI, do not correspond to the Annex I Priority Habitat 91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae).*

Ecological Interest	Links to Annex I Habitats
County Importance	This habitat does not correspond to Annex I habitats, however the habitat is limited within the study area and is therefore considered to be of high conservation value.

Scrub (WS1)

Scrub can be found on the dryer areas of Cutover Bog PB4, adjacent to road sides and along the shores of Lough Talt. Willow dominated scrub can be found on the banks of the Eighnagh River. Species such as Ash, Hazel (*Corylus avellana*), Blackthorn (*Prunus spinosa*), Goat Willow (*Salix caprea*), Hawthorn, Sycamore (*Acer pseudoplatanus*) and Gorse (*Ulex* spp.) can be found within the Scrub WS1 habitats. The Scrub vegetation adjacent to the road contains Holly (*Ilex aquifolium*), Rowan, Gorse, Hawthorn, Ash and Bramble.

Ecological Interest	Links to Annex I Habitats
Local Importance (Higher Value)	This habitat does not correspond to Annex I habitats, however can provide local bird and small mammal species with shelter and foraging habitat.

Image 1: Lough Talt, view from South of Lake

Image 2: Stonewort *Nitella* sp.

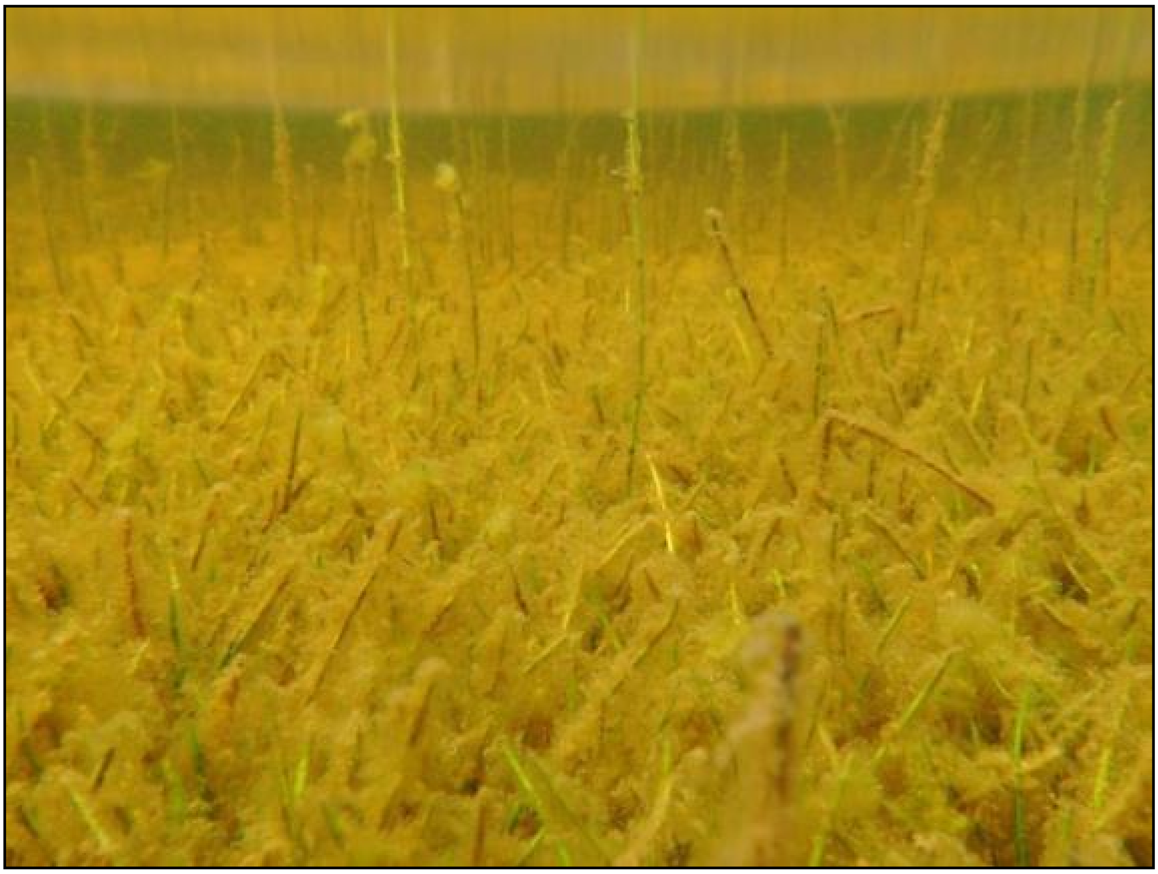


Image 3: Shoreweed *Littorella uniflora*

Image 4: Eighnagh River

Image 5: Improved Agricultural Grassland on the Western Shores of Lough Talt

Image 6: Dry Neutral and Calcareous Grassland GS1 on Banks of Lough Talt

Image7: Dry Humid Acid Grassland Mosaic with Wet Heath HH1 Vegetation

Image 8: Wet Grassland on the Northern Shores of Lough Talt


Image 9: Wet Heath Habitats with Rock Outcrops and Small Stream


Image 10: Dense Bracken on the Slopes of Crummus Hill to the West of Lough Talt

Image 11: Cutover Bog to the Northwest of the Lake

Image 12: Grass of Parnassus (*Parnassus palustris*) on Rich Fen and Flush Habitat to the Northwest of the Lake

Image 13: Wet Willow Alder Ash Woodland on the Eastern Shores of Lough Talt

Image 14: Holly and Hawthorn Scrub adjacent to roads around Lough Talt

Image 15: Drainage channel along the site's southern boundary

Image 16: Wet grassland and drainage channel near the southern boundary of the proposed WTP site

Image 17: Recently-felled Woodland (WS5) and adjoining drainage channel located to the north of the proposed WTP site

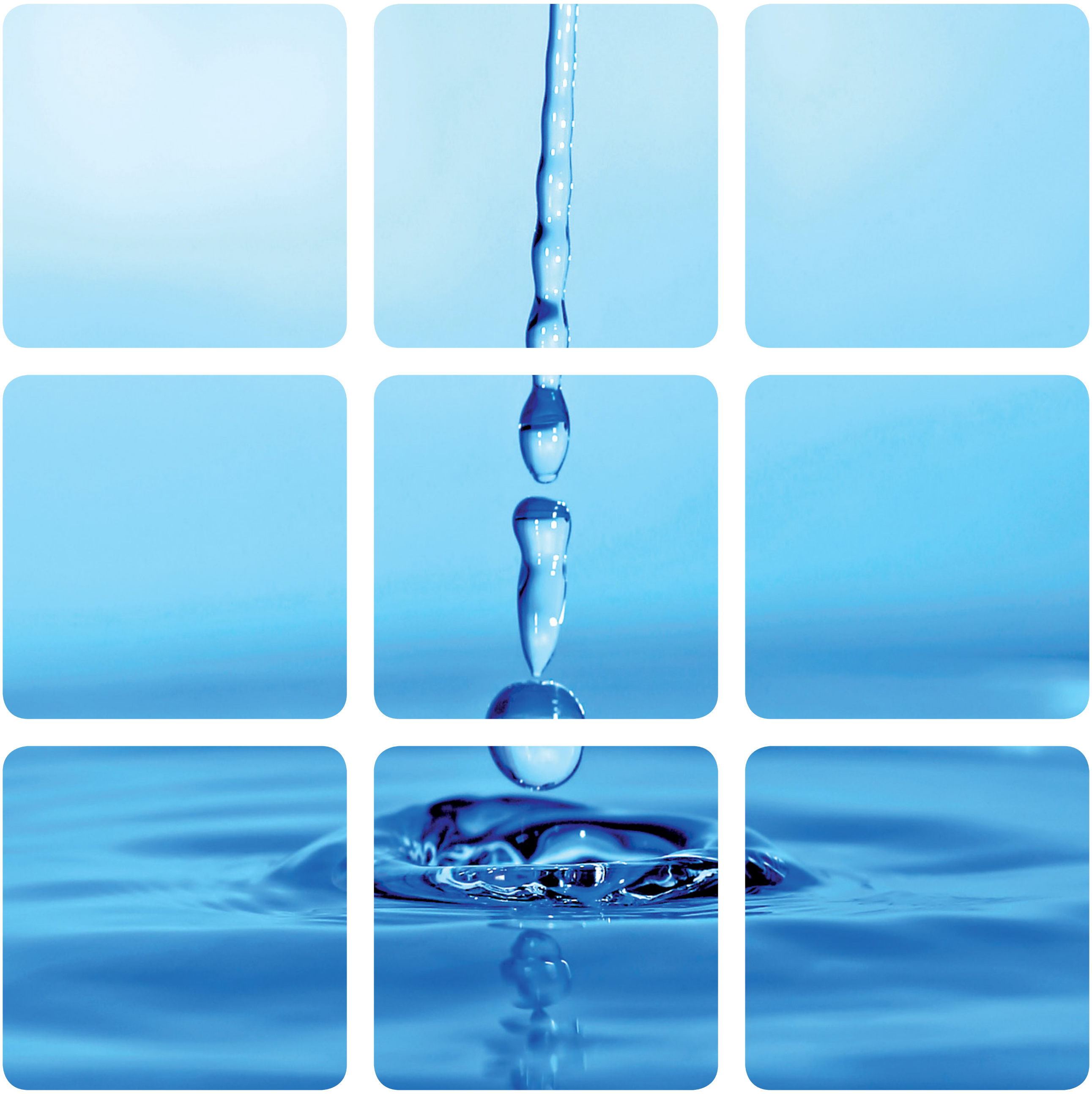
Image 18: Establishing willow scrub on the proposed WTP site

APPENDIX F – CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

Lough Talt Regional Water Supply Scheme

Construction Environmental Management Plan

May 2018



MGW0214CR0005

Lough Talt Regional Water Supply Scheme

Proposed Water Treatment Plant Upgrade Construction Environmental Management Plan

Document Control Sheet

Client:	Irish Water
Project Title:	Lough Talt Regional Water Supply Scheme – Water Treatment Plant Upgrade
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF IMAGES

1 INTRODUCTION

All construction projects require the preparation of a site specific Construction and Environmental Management Plan (CEMP) in order to ensure that the project is constructed in accordance with best practice and with the minimum impact on the surrounding environment. This CEMP also incorporates all mitigation and best practice measures as outlined in the Natura Impact Statement (NIS) prepared for the proposed development.

This CEMP relates to the construction of an upgrade to the Lough Talt Water Regional Water Supply Scheme (RWSS) Treatment Plant (WTP).

This document has been prepared by RPS on behalf of Irish Water in order to ensure all best practice mitigation measures presented in the NIS, which has also been prepared by RPS, will be taken on board by the contractor at construction stage should the appropriate consents be received.

1.1 SCOPE OF CONSTRUCTION AND ENVIRONMENTAL MANAGEMENT PLAN

This document is a CEMP and will be included in the planning application to Sligo County Council for the WTP upgrade.

This CEMP defines the work practices, construction management procedures, and management responsibilities relating to the construction of the proposed WTP upgrade.

This CEMP details the environmental safeguards that will be implemented during the project construction phase. The plan also includes the best practice and mitigation measures to be implemented to manage the potential environmental impacts that construction works may have on the surrounding environment. A number of sub-plans have been prepared to ensure appropriate environmental management of specific aspects of the project, including:-

- Site Access,
- Surface Water Management,
- Soil Stability Management,
- Ecology,
- Landscape & Visual,
- Archaeology & Cultural Heritage,
- Spoil Management Plan,
- Materials Storage,
- Construction Waste Management Plan,
- Air & Dust Management,
- Noise & Vibration Management,
- Traffic Management, and
- Site Reinstatement – Post Construction.

This CEMP has been prepared based on the information available at the planning stage of the proposed WTP upgrade. The CEMP is a working document which is updated throughout the pre-construction phases of the proposed development. The CEMP outlines clearly the construction methodology constraints and mitigation measures that must be strictly adhered to should the proposed development and associated works be granted permission. The CEMP will be subject to ongoing review and will include a record of the environmental measures undertaken and consultation with the National Parks and Wildlife Service (NPWS) and the Inland Fisheries Ireland

(IFI). Any alterations will be for the improvement of the CEMP. The proposed protection measures described in the CEMP will be carried out, further to the requirements of the consenting authorities.

The CEMP is to be read in conjunction with, the following documents:

- Lough Talt Regional Water Supply Scheme NIS; and
- Drawings prepared as part of the proposed development and any amendments to same (**Appendix A Planning Report**).

This CEMP describes how the Contractor (when appointed) will implement a site construction management system for this project to meet the specified contractual, regulatory and statutory requirements, best practice mitigation measures. It will be the appointed Contractor's responsibility to implement an effective construction management system to ensure that all environmental requirements for the construction of this project are met. The Contractor will be responsible for the development of a series of Construction Method Statements (CMS) for the construction, outlining the proposed methodology for the various aspects of the proposed development. These CMS's will then be incorporated into later versions of this CEMP. All relevant drawings and management plans will be appended to the CEMP.

All site personnel will be required to be familiar with the CEMP's requirements which are relevant to their role on site. The plan describes the project organisation and lists those procedures that will be developed and adopted on site.

The CEMP also defines the roles and responsibilities of the various parties to the construction contract.

1.2 ROLES AND RESPONSIBILITIES/MANAGEMENT STRUCTURE

This section sets out the roles and responsibilities of the principal parties involved in the construction and execution works of the proposed Water Treatment Plant Upgrade. In addition to this, it outlines the lines of communication between the various parties. The roles and responsibilities outlined below are indicative and will be updated upon appointment of Employer's Representatives, Designers and the Contractor.

The responsibilities of the Contractor's site staff shall be as follows:

1.2.1 Contract Project Manager

The Contractor's Project Manager for the Works reports directly to the Contractor. He/she is responsible for:

(a) Liaison with clients Project Manager;

(b) The implementation of the CEMP;

(c) Management of the overall Project Programme;

(d) Co-ordinating the road construction team/contractors;

(e) Implementing the Contractor's Health and Safety Plan;

(f) Liaison with the client representative staff;,

(g) Production of construction programmes; and

(h) Maintaining a project diary.

1.2.2 QA Manager

The Contractor's QA Manager for the Works reports to the Project Manager. He/she is responsible for:

(a) The implementation of the CEMP;

(b) Management of quality issues relating to the project;

(c) Co-ordinating the construction teams;

(d) Ensuring that method statements are in place;

(e) Implementing the Contractor's Health and Safety Plan; and

(f) Liaison with the client's representative staff.

1.2.3 Site Agent

The Contractor's Site Agent reports to the Project Manager. He/she is responsible for:

(a) Implementing the CEMP;

(b) Management of the project, particularly in relation to the roadworks;

(c) Management of all plant and labour activities relating to the section of works for which he is responsible;

(d) Implementing the Contractor's Health and Safety Plan;

(e) Liaison with the client representative staff;

(f) Production of construction programmes; and

(g) Maintaining a project diary.

1.2.4 Senior Engineers

The Contractor's Senior Technical Engineers report to the Project Manager. They are responsible for:

(a) Implementing the CEMP;

(b) Materials procurement;

(c) Design of Works;

(d) Administration;

(e) Programming and planning;

(f) Implementing the Contractor’s Health and Safety Plan; and

(g) Maintaining a project diary.

1.2.5 Health and Safety Officer

The Contractor’s Health and Safety Officer for the Works is appointed by the Contractor and reports to the Project Manager. He/she is responsible for:

(a) Carrying out duty of Health & Safety Coordinator Construction Stage;

(b) Safety induction of all staff and personnel on site;

(c) Implementing the Contractor’s Health and Safety Plan; and

(d) Auditing the Site Health & Safety & updating Plan as necessary.

1.2.6 Environmental Officer/Engineer

The Environmental Officer is appointed by the Contractor and reports to the Project Manager. He/she is responsible for:

(a) Implementing the Environmental Requirements of the CEMP and updating it as necessary in particular **Section 4** below;

(b) Management of all environmental aspects of the construction works;

(c) Liaison with the site specialists such as ecologist, archaeologist etc.;

(d) Ensuring all relevant best practice mitigation measures are implemented as required;

(e) Ensuring all monitoring proposals are implemented as required;

(f) Reviewing monitoring results;

(g) Training of staff in all environmental issues;

(h) Provision of Tool Box talks to contractors as required;

(i) Ad hoc- Environmental Inspections;

(j) Liaison with the client representative staff;

(k) Auditing the construction works from an environmental viewpoint;

(l) Maintaining regular contact and liaison with environmental specialists;

(m) Producing update reports on environmental compliance;

(n) Reporting on any non-compliances; and

(o) Implementing measures for ensuring close out of non-compliances.

2 PROJECT DESCRIPTION

2.1 PROPOSED SCHEME

It is proposed to construct the proposed WTP upgrade within and adjacent to the existing WTP site. The site is located in the Gortersluin townland adjacent to the R294 Regional Road. The existing WTP site will be expanded as necessary to include for the new treatment process.

The WTP upgrade site is bordered by recently felled Coillte forestry to the east, west and north. It will be accessed via a new entrance off the R294 regional road and will occupy a site area of 0.77 hectares and will necessitate the acquisition of additional lands adjacent to the existing WTP site.

Image 2.1: Existing Water Treatment Plant Site

2.1.1 Existing Environment

The proposed WTP upgrade site is set within the footprint of the existing Lough Talt RWSS WTP. This area supports the existing built infrastructure of Lough Talt RWSS which includes operations buildings, holding tanks, boundary walls and some built ground to facilitate vehicular access. The fringes of the WTP upgrade site support amenity grassland, in addition to sections of unmanaged grassland that support a mosaic of dry meadows and grassy verge and wet grassland habitat. The proposed WTP upgrade site is set within an area dominated by recently felled Coillte conifer plantation and mature conifer plantation to the south. The WTP is situated on relatively steep sloping ground, situated on the higher reaches of the Eighnagh river valley located less than 100m south. The footprint of the proposed WTP upgrade supports drainage channels that form connectivity to the Eighnagh River which is designated under the River Moy SAC (Site Code 002298).

The site will be accessed via a shared access with an existing Coillte entrance off the R294 regional road and will occupy a site area of 0.85 hectares and will necessitate the acquisition of additional lands from Coillte adjacent to the existing WTP site. Coillte have confirmed that the existing access is used infrequently and it is not expected that the construction or ongoing operation of the Water Treatment will have a significant impact on Coillte operations. The upgrade works on the existing access road will be coordinated with Coillte to ensure that any required access is maintained during the works.

The raw water supply for the WTP upgrade is from Lough Talt which is designated as part of the Lough Hoe Bog (SAC). Lough Hoe Bog SAC is designated for the Annex I habitats including [3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*), [7130] Blanket bogs (*if active only), [1013] Vertigo's whorl snail (*Vertigo geyeri*) and [1092] White clawed crayfish (*Austropotamobius pallipes*).

2.1.2 Nature and Extent of Proposed Works

2.1.2.1 Raw Water Abstraction

The Lough Talt RWSS has been continuously abstracting water from Lough Talt since the 1950s. During the late 1990s the abstraction reached a peak of 10.5 MLD, however due to significant water conservation investment, the average abstraction is now approximately 8 MLD (average daily abstraction for the period 2014-2017 was 7,800 m^3).

2.1.2.2 Proposed Water treatment Plant Upgrade

The proposed development will include the upgrade of the existing WTP with a treated water production capacity of 8 MLD, matching the current abstraction levels. The upgraded plant will treat the Lough Talt raw water to the required quality standards to ensure that water supplied to the Lough Talt RWSS, will meet standards set out in the Drinking Water Regulations, and risks to public health will be minimised. All backwash water (water refluxed from the filtration process) will be recycled within the water treatment process. Therefore, there is very little 'lost' water from the process as it is reused. The only waste from the water treatment process will settled solids (from the backwash water) which will be taken off-site on a regular basis via a tanker truck. The settled solids will be taken to an Irish Water Waste Water Treatment Plant (WWTP) in the area for dewatering and ultimately for reuse elsewhere or for disposal at a licensed facility.

The drawings in **Appendix A** of the Planning Report demonstrate the proposed treatment process.

The principal elements of the WTP upgrade include the construction of the following:

Treatment Elements to address the public health risks including;

- Process units e.g. pressure filters, ultraviolet treatment and disinfection;
- Temporary containers to house the process units, controls, chemical storage and dosing, including:
  - 4 containers (12.2m L x 2.4m W x 2.6m H) to house the pressure filters
  - 2 containers (6 m x L x 2.4 m W x 2.6m H) to house UV disinfection units
  - Kiosks to house controls and pumping equipment
- New Chlorine Contact Tank (12m diameter x 4m high)

- Used wash water equalisation and settling tanks;
- Solids settling and storage tanks; and
- Various smaller underground chambers, for example; flow measurement chambers.

Ancillary Items to facilitate the Treatment plant works including;

- New access onto the R294 and internal access roads, footpaths and parking areas. The existing entrance will be closed off upon completion of the works;
- Site works including cut and fill to facilitate the installation of tanks and roadways;
- Site fencing;
- Site drainage, ducting and internal pipework;
- Landscaping to include indigenous screening planting, mounding, retaining walls and general site landscaping; and
- Attenuation of storm water to reduce run off to Greenfield rates; and

Proposed Mitigation measures including;

- Irrigation system at fen habitat as detailed in the **NIS**.

There will be no process outputs emanating from the proposed WTP upgrade. Chemicals and hydrocarbons associated with the water treatment process will be stored in bunded and contained areas (with 110% capacity) of the WTP.

The use of containerised units and precast concrete tanks will facilitate the removal of these structures when they are no longer required.

The proposed design of the WTP upgrade is presented in **Appendix A** of the **Planning Report**.

2.1.2.3 Wastewater

There will be no process wastewater discharge as a result of the proposed water treatment works. All backwash waters will be recirculated to the head of the plant for treatment. Settled Solids from the backwash process will be stored in tanks prior to being taken off-site via a tanker truck. The settled solids will be taken to an Irish Water WWTP in the area for dewatering and ultimately for reuse elsewhere or for disposal at a licensed facility.

Surface water will be collected, attenuated and discharged via a Class 1 by-pass hydrocarbon interceptor to the existing drainage channels on-site which ultimately discharge to the Eighnagh River. The hydrocarbon interceptor will be provided with an alarm system to alert the WTP operator when 90% full and will be emptied to a suitable licenced waste facility. In addition, routine maintenance will be completed for the hydrocarbon interceptor in accordance with manufacturer's instructions.

Chemicals will be stored on the site both inside the building and outside. Chemical tanks will be provided with 110% bunded volume. Chemicals used as part of the water treatment process will include Sodium Hypochlorite and Liquid Ammonium Sulphate for Disinfection and Hydrofluorosilicic Acid for fluoridation purposes.

2.1.3 Construction Period and Sequence

The construction of the proposed WTP upgrade will be performed over a number of months (anticipated to be 9 months.

2.1.4 Construction Working Hours

The hours of construction activity will be limited to avoid unsociable hours. Construction operations shall generally be restricted to between 08:00 hours and 20:00 hours Monday to Friday and 08:00 hours and 18:00 hours on Saturdays, with no Sunday or Bank Holiday operations proposed. Any works outside standard hours will be agreed in advance with the local authority / Irish Water.

The site contractor will be required to conform to relevant standards and regulations for Health and Safety on site (Safety, Health and Welfare (Construction) Regulation 2013), which will mitigate against any risks to the temporary working community.

2.2 HEALTH AND SAFETY

All activities performed during the course of work undertaken by the Contractor on this Contract shall be in accordance with the requirements of the Safety, Health and Welfare at Work Act 2005 (as amended) and regulations made under this Act.

The Client shall nominate a project supervisor for the design process and construction stage (PSDP and PSCS) in accordance with the Safety, Health and Welfare at Work (Construction) Regulations, 2013.

Risk assessments and method statements for all elements of the works are to be submitted to the Client and the Local Authority prior to commencement of works.

2.3 CONTRACTOR WELFARE FACILITIES

The Contractor will be required to install temporary portable toilet facilities at the temporary site compound. These units will be maintained and the waste collected therein will be disposed of using an appropriately licensed contractor to an authorised treatment facility.

All surplus plant and materials shall be stored in this location (site compound) when not in use. First Aid facilities will be kept on site during operational hours. Any fuel storage containers used for various items of plant will be located within a sealed containment bund within the site compound.

Telephone communications will be by mobile phone.

Any runoff from the compound will be routed through a silt trap and hydrocarbon separator prior to being discharged to a watercourse (roadside drainage channel or otherwise). Any storage areas will be clearly identified and agreed with all relevant parties in advance of construction.

3 OBJECTIVES OF THE CEMP

The key performance objective of this CEMP is to ensure compliance with all environmental legislation and approvals, including minimising pollution and waste generation and minimising environmental impacts.

The objectives of the CEMP as described in the subsequent sections have been developed to identify, assess and satisfy the following contract performance criteria:

- The intent of the NIS must be satisfied and mitigation, best practice and construction design must be adhered to;
- Requirements from key project stakeholders; and
- The requirements of the Contractor's contract obligations must be satisfied in full.

All of the measures outlined in the CEMP are based on national and international best practice and have proven to be effective in this and other jurisdictions. The proposed measures have been specifically tailored to suit this proposed development having regard to the particular environmental constraints.

The following is a list of the main environmental guidance and best practice documents used in the development of the customised avoidance, protection and mitigation measures incorporated into the proposed development:

1. Good practice guidelines on the control of water pollution from construction sites developed by the Construction Industry Research and Information Association (CIRIA) in particular,
   - C532 *Control of water pollution from construction sites: guidance for consultants and contractors* (Masters-Williams *et al*, 2001), and
   - SP156 *Control of water pollution from construction sites – guide to good practice* (Murnane *et al*, 2002).
2. Series of Ecological Assessments on Arterial Drainage Maintenance No.10. Ecological Impact Assessment (EcIA) of the Effects of Statutory Arterial Drainage Maintenance Activities on White-clawed Crayfish (*Austropotamobius pallipes*) http://www.opw.ie/media/Issue%20No.%2010%20EcIA%20White-clawed%20Crayfish.pdf
3. NRA (2008) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. National Roads Authority, Dublin,
4. NRA (2010) Guidelines for the Management of Noxious Weeds and Non- Native Invasive Plant Species on National Roads. National Roads Authority, Dublin,
5. IFI (2016) Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters.
6. Murphy, D. (2004) Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites. Eastern Regional Fisheries Board, Dublin, and
7. DOMNR (1998). Fishery guidelines for Local Authority works. Department of the Marine and Natural Resources, Dublin.

4 MANAGEMENT PLANS

As part of the development of this CEMP, a series of Management Plans (or Sub-Plans) have been prepared to ensure appropriate environmental management of specific aspects of the project. The Sub-Plans document the aspects, impacts, safeguards and inform the monitoring requirements for each key environmental element.

The particular requirements outlined within the following sub-plans are a summary of key implementation constraints and requirements with which the Contractor shall comply. The list is not exhaustive and must be read in conjunction with the NIS and associated appendices.

4.1 SITE ACCESS PLAN

4.1.1 Introduction

It is envisaged that there will be one site compound which will include short term staff welfare facilities, and plant and materials storage for the proposed works.

Site access to the construction compound during the project’s construction phase will be achieved via the existing access to Coillte lands.

Construction traffic will require regular access to the site at varying times throughout the construction phase. It will be necessary to put procedures in place to effectively manage construction related traffic both on and off site.

This Site Access Plan will form the basis for the development of a Construction Traffic Management Plan (CTMP).

4.1.2 Site Access Junction

Access to the site will be limited using a barrier to prevent public access, illegal dumping, use of off road vehicles etc. Vehicle and pedestrian access to and from the proposed site, including signage will be established in line with the requirements of the competent authority.

4.1.3 Construction Traffic Management Plan

Should it be required by the competent authority, prior to the commencement of construction, a draft CTMP, will be prepared by the Contractor and submitted to the competent authority for approval.

The aim of a CTMP is to put in place procedures to manage construction traffic effectively. Any such plan will consider construction traffic accessing the site via the public road network as well as traffic circulation within the construction site. It will also outline measures to enhance the efficient transportation of construction materials and machinery whilst minimising delay and disruption to the general traffic.

A typical Traffic Management Plan will:

- Identify sensitive areas (e.g. schools and homes);
- Be aware of road restrictions, e.g., narrow roads, bridges with restrictions, etc.;
- Identify the location of suitable parking facilities for private cars and plant;
- Ensure there are designated vehicular routes in site with speed restrictions;
- Ensure safe access and egress from site;
- Gain permissions for any required road closures, diversions etc. from the relevant bodies;
- Consult with An Garda Síochána and relevant local authorities;
- Schedule site deliveries outside of times of peak traffic volume; and
- Ensure erection of the required signage as per Chapter 8 of the Traffic Signs Manual.

Should a Construction Traffic Management Plan need to be prepared for the proposed development, this should take into account any planned intensive period of traffic volumes associated with the proposed Water Treatment Plant.

The following measures will be incorporated into the CTMP:

- In order to minimise the level of construction traffic all materials where possible will be sourced locally;
- Machinery deliveries and construction vehicle movements to the site will be scheduled so as to spread the arrival and departures of construction vehicles over the day and avoid peak traffic on the local road network;
- During the construction of the access road, the delivery of material to the site will be restricted to non-peak hour traffic in order to minimise disturbance to local road users;
- Should the local authority require it, both the local authority and road users will be notified of the dates and times that material deliveries will be transported to the site; and
- Road conditions will be reviewed prior to construction and any necessary repairs carried out prior to transport.

4.2 SURFACE WATER MANAGEMENT PLAN

4.2.1 Introduction

This Surface Water Management Plan (SWMP) addresses the broad controls and strategies to be implemented on site to control surface water and to protect existing water quality, and is based on site knowledge at Scheme Confirmation Stage.

The SWMP and associated drainage strategy can only be amended by improvement with regards to environmental protection and must take cognisance of all best practice and mitigation measures recommended within this outline plan and in the NIS.

An indicative layout of the outline drainage strategies during the construction and operational phases are presented within the drawing package (**Appendix A** of the **Planning Report**).

The key factors in erosion and sediment control for land based works are to intercept and manage runoff at source. This limits the potential for soils to be eroded before entering watercourses through overland runoff. The following general guidelines for erosion and sediment control which are to be adhered to during the construction phase are largely based on Goldman *et al.,* (1986):

i. Construction shall be halted during periods of heavy precipitation and run-off to minimise soil disturbance;

ii. Stockpile areas of soil and aggregate material will not be stored to within 30 metres of the drainage channels draining the site; and

iii. Silt fencing shall be installed along the perimeter of the on-site drainage channels to retain eroded or liberated sediments.

No machinery shall be allowed to enter or cross the site's drainage channels.

4.2.2 Objectives

The objects of this outline SWMP are to:

- Provide overall surface water management principles and guidelines for the construction phase of the Lough Talt WTP upgrade;
- Address erosion, sedimentation, attenuation and water quality issues; and
- Present measures and management practices for the prevention and/or mitigation of potential downstream impacts.

The proposed WTP upgrade supports connectivity to the Eighnagh River which is designated as part of the River Moy SAC (Site Code: 002298) and the water dependent qualifying species for the SAC; i.e. otter, white-clawed crayfish, brook lamprey and Atlantic salmon are likely to utilise the Eighnagh and those areas located downstream in some capacity.

The provision of a properly designed, constructed and maintained drainage and attenuation system is a fundamental requirement for this project. The construction of a drainage system brings with it a requirement to ensure that peat and soil stability is maintained throughout the construction phase. The maintenance of existing water flows and the prevention of pollution, as a result of sediment runoff, during the construction phase is a key objective.

The protection of water quality and prevention of pollution events requires a sustained and concentrated input from the Contractor with regard to the provision and maintenance of sediment control structures. The drainage system, as it is constructed, must have minimal impact on the existing drainage regime on site.

4.2.2.1 Construction Stage SWMP

During the project construction phase, surface water drainage will be directed (via overland flow) and collected within a catch-all swale paralleling the site's southern boundary. The collected water will then be directed to a sediment basin and control pit for attenuation. Once sufficiently settled, the collected water will be released via a rock spillway to the drainage channel on the sites southern boundary (**See Appendix A** of the **Planning Report Drawing No. MGW0214DG0025)**. During the construction phase, maintenance of the drainage system and attenuation area will include the activities required to keep the drainage system operating effectively. The appointed contractor will have responsibility for maintaining the efficacy of the on-site drainage and attenuation system during the project's construction phase.

4.2.2.2 Operational Stage SWMP

During the project operational phase, all surface water will be positively drained via the site's storm sewer designed to drain all hard standing areas. All surface water falling on the proposed WTP upgrade hard standing areas will be directed to a Class 1 bypass petrol interceptor near the sites south- boundary. From here, the collected water will be passed to a sediment basin along the site's southern boundary and the settled water will outfall to the existing drainage network via a rock spillway at Greenfield run off rates (**See Appendix A** of the **Planning Report, Drawing No. MGW0214DR0024**). The WTP upgrade operator will have the responsibility for maintaining the efficacy of the site's surface water drainage, hydrocarbon interceptor and sediment basin.

4.2.3 Best Practice, Mitigation and Control Measures

To minimise surface water impacts on and off-site, best management practices will be adopted for the construction phase of the Project. A range of techniques will be used to minimise impacts including:

- Undertaking works in compliance with this CEMP;
- Preparation and implementation of 'Site and Environmental Procedures' (Refer to **Section 4.9**of the CEMP) for all areas of work;
- Ensuring the design and construction of works do not result in land degradation;
- Managing fuels, oil and other chemicals accordingly to appropriate guidelines; and
- Ensuring that the disposal of wastewater is undertaken in compliance with statutory requirements.

There are a number of 'Site and Environmental Procedures' listed within **Section 4.9** that will contain detailed measures to minimise soil and water impacts. The relevant procedure references are presented below, and will be developed by the Contractor, when appointed. These procedures will form part of the CEMP, and will be continually updated where necessary:-

ENV-01	Awareness & Training
ENV-02	Environmental Emergency Response
ENV-03	Record Keeping, Auditing and Monitoring
ENV-04	Erosion Control
ENV-07	Protection of Water Quality
ENV-011	Management of Excavated Material

These procedures can only be amended by improvement with regards to environmental protection and must take cognisance of all best practice and mitigation measures recommended by the NIS and associated technical reports.

The following subsections outline the various elements of the preliminary SWMP and Drainage Strategy proposal as illustrated within the drawing package presented in Appendix A of the Planning

Report. The proposed measures outlined in the below sections have been devised to reduce the potential impacts of the proposed WTP upgrade development on water quality.

Sediment Control

The main construction related potential impact on water quality on site is the release of sediments into existing watercourses and drainage channels. The release of silt and silt laden water to the surrounding environment can be caused by various construction related activities, such as dewatering and pumping of excavations, run-off from exposed ground, run-off from spoil storage areas, etc. Where runoff water is contaminated with silt or other pollutants such as oil, this water must not be pumped or allowed to flow directly or indirectly into surface waters or groundwater without treatment.

Sediment control for the proposed WTP upgrade construction will comprise a combination of silt fencing, as well as attenuation ponds or settlement areas and rock spillways.

Swale Channel / Sediment Basin

Silt traps or sediment basins are containment areas where sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out or before the runoff is discharged.

For the purposes of the proposed WTP upgrade construction, a linear swale channel and geotextile lined sedimentation basin will be created along the site's southern boundary. All surface water flow draining the site will be directed toward a linear sedimentation basin or directly to the sedimentation basin itself. In addition, silt fencing will be placed between the sedimentation basin and swale and the existing drain. Silt fencing will also be placed along the south-east boundary of the site to direct water to the sedimentation basin. The water collected in the sedimentation basin will allow the flow velocity to be reduced so that sand, silt and coarse organic material are deposited and can be excavated with ease. Once settled, the attenuated water will be released at Greenfield rates to the drainage channel on the sites southern boundary.

Proposed Preliminary Design:-

- It is proposed to construct sediment and erosion control features near the site's southern boundary (See **Appendix A** of the **Planning Report**. As shown on the drawings, surface water discharges shall be routed through a sedimentation basin in order to remove sediment particles from suspension;
- Sediment control devices have been located as near as practical to areas producing the sediment, e.g., excavations, stockpiles, etc., and at regular intervals along roadside drainage channels;
- Sediment control devices have been designed and sited to utilise the site's natural drainage pattern, therefore ensuring greater efficacy with run-off capture and subsequent attenuation,
- Sediment control devices have been located in areas where they can be maintained and readily accessed (i.e. sediment removal); and
- A rock spillway has been designed at the outlet and the intersection of the receiving drainage channel.

Inspection and Maintenance:

- Inspect and test sediment control devices on project start-up;
- Inspect sediment control devices prior to forecast rain, daily during extended rain events, otherwise inspect weekly throughout the construction period;
- Inspect outlet area for erosion and stabilise if required;
- Inspect sedimentation basin for seepage and structural soundness, repair as needed;
- Inspect silt fencing for damage and wear, repair or replace as needed – retain sufficient supplies of silt fencing on site for repair/replacement works;
- Inspect outlet structure and spillway for any damage or obstructions. Repair damage and remove obstructions as needed – retain sufficient supplies of clean drainage stone on site for repair/replacement works; and
- Sediment that accumulates in the trap must be periodically removed in order to maintain effectiveness. Sediment should be removed when the sediment accumulation reaches 50% of the trap capacity. Collected sediment should be removed to a licensed landfill facility.

Silt Fencing

A silt fence is made of a filter fabric that detains sediment-laden water, promoting sedimentation behind the fence. Silt fences are suitable for perimeter control, placed below areas of sheet flows discharge from the site. They should also be used as interior controls below disturbed areas where runoff may occur, for example below the toe or down slope of exposed and erodible slopes. It is proposed to provide silt fencing around the perimeter of the spoil storage areas.

Proposed Preliminary Design:

- Silt fencing will be erected between the sedimentation basin and the existing drainage channel and along the site's south- eastern boundary;
- Along unprotected channels where appropriate;
- Around temporary spoil storage and stockpile areas;
- An emergency supply of silt fencing will also be retained on site;
- Allow sufficient space for runoff to pond behind the fence and to allow sediment removal works between silt fence and toes of slopes or other obstructions;
- The ends of the filter fence are to be turned uphill to prevent water flowing around fence;
- Silt fences are to remain in place until the disturbed area is re-vegetated and/or stabilised;
- Choice of filter fabric to be based on soil conditions on site. The designer (at Detailed Design Stage) is required to specify a filter fabric type that will allow free drainage and prevent clogging, while also retaining soil particles behind,; and
- Silt fencing to be erected in accordance with Detailed Design and Manufacturers Guidelines.

It should be noted that silt fences are not to be used in streams, drainage channels or anywhere flow is concentrated.

Inspection and Maintenance:

- Inspect silt fencing prior to forecast rain, daily during extended rain events, otherwise inspect weekly throughout the construction period;
- Repair or replace split, torn, slumping or otherwise damaged fencing. Note manufactures life span expectancy and replace when required; and

- Sediment that accumulates behind the fence must be periodically removed in order to maintain its effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the trap capacity. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed of at an appropriate location.

Concrete and cement

Wet concrete and cement are very alkaline and corrosive and can cause serious pollution to watercourses. The following precautions will be put in place with regard to Concrete and Cement:

- Disposal of raw or uncured waste concrete must be controlled to ensure that the watercourse or sensitive aquatic features will not be impacted;
- Best practice in bulk-liquid concrete management addressing pouring and handling, secure shuttering / form-work, adequate curing times;
- Where shuttering is used, measures should be put in place to prevent against shutter failure and control storage, handling and disposal of shutter oils;
- Wash water from cleaning ready mix concrete lorries and mixers may be contaminated with cement and is therefore highly alkaline. Due to the size of the site and the proximity of sensitive watercourses, it is recommended that lorries and mixers are washed out off site; and
- Cement dust must be controlled as it is alkaline and harmful to the surrounding ecology. Activities which result in the creation of cement dust must be controlled by dampening down areas.

Fill material

The rock type underlying much of the site is schist, a coarse grained metamorphic, siliceous rock. Where fill material is required, it should be recovered and reused from any excavations within the site. The importation of foreign material should be limited, however if it is required it should be the same rock type as found on site; i.e. siliceous material.

Excavated Material

Aggregate material and soils excavated as part of the proposed construction works will be retained within the footprint of the proposed WTP (where possible). To this end, it is proposed to incorporate the excavated parent material as part of the landscape design (where suitable for such works) or to utilise excess excavated material for screening purposes. Any excess material will be disposed of off-site at a licensed facility.

Hydrocarbons

Fuel and hydraulic fluids will be stored within a designated site compound. Refuelling will only take place in the site compound. All stationary plant will be placed on drip trays to prevent leaking oils reaching the river or entering groundwater.

No washings or waste materials of any kind will be directed into the site’s drainage channels. Machinery on site will have pollution control kits on hand in the event of an emergency.

4.3 ECOLOGY MANAGEMENT PLAN

4.3.1 Objectives

The objective of this ecology management plan is to develop a construction methodology and programme that minimises the impact on site ecological integrity and composition.

4.3.2 General Flora and Fauna Mitigation Measures

- A toolbox talk will be carried out with all staff prior to commencement of works to highlight and identify issues relating to potential ecological impact and mitigation;
- The Contractor will comply with the general and specific best practice and mitigation measures outlined in the NIS;
- The Contractor will comply with all measures outlined in **Sections 4.2**above to ensure the protection of water quality and consequently aquatic ecology; and
- Appropriate measures, drawn up by an ecologist, will be put in place to avoid the spread of invasive species prior to the commencement of any works.

4.3.3 Birds

No scrub clearance, tree felling or other removal of vegetation should occur during the bird breeding season from 1st March to 31st August.

4.3.4 Invasive Species

Site walkover surveys confirmed that the proposed WTP upgrade does not support invasive plant species. Source locations for materials (aggregate, fill or other) introduced to the site during the construction phase will be free from non-native invasive species. In addition, routine monitoring of the proposed works area will be undertaken to ensure that invasive plant species have not been introduced to the site or its surrounds as a result of the construction works.

The source locations for materials (aggregate, fill or other) which are introduced to the site during the construction phase of the project will be free from non-native invasive species.

4.4 MATERIALS STORAGE PLAN

4.4.1 Introduction

The purpose of this Materials Storage Plan is to ensure a good standard of ‘housekeeping’ within the proposed WTP upgrade construction site. The appointed contractor must plan, manage and monitor their work so it is carried out safely and without risks to health, including careful planning on how the site will be kept tidy and housekeeping actively managed.

Limited storage of materials is proposed at this site; however any storage should take account of the content of this plan. Safe and efficient materials storage depends on good co-operation and co-ordination between all site personnel including, contractors, suppliers and the construction trades.

All Site Contractors will be required to implement both this 'Materials Storage Plan' and the site 'Construction Waste Management Plan' to ensure a good standard of site housekeeping across the site.

4.4.2 Site Compound

The Site Contractor will be responsible for the designation of a site compound to store construction plant, materials, waste, flammable substances e.g. flammable liquids and hazardous substances. Prior to the commencement of construction works, a pre-designated site compound will be approved by the appointed Environmental Officer. The site compound will be signed and marked appropriately. Flammable materials will usually need to be stored away from other materials and protected from accidental ignition. The site compound will be 50m from any aquatic zone and will not support connectivity to drainage channels or any watercourses. The site compound will be located on gently sloping terrain. The Site Contractor will be responsible for ensuring that the construction site compound is kept safe, tidy and orderly throughout the construction phase.

4.4.3 Storage of Plant and Construction Materials

All excess plant and construction materials shall be securely stored in the site compound until such time as they are immediately required on site. Such excess plant and materials are expected to be minimal as material will be brought to site and utilised as needed.

Excavated materials shall be re-used on site where possible, in line with site reinstatement objectives 'Site Reinstatement Plan – Post Construction', 'Spoil Management Plan' and 'Soil Stability Management Plan'.

4.4.4 Storage of Hydrocarbons

- To minimise any impact on the underlying subsurface strata and surface water from material spillages all oils and solvents used during construction will be stored within temporary bunded areas. The design (volume and construction) of all bunds will conform to standard bunding specifications. The retention capacity of bunded areas will be as follows:
    - 110% of the capacity of the largest tank or drum to be stored within the bunded area; and
    - 25% of the total volume of substance which could be stored within the bunded area.
- Drip trays and spill kits will be retained on site to ensure that any spillages or leakages are dealt with immediately. All dispensing of fuels and hazardous materials will occur in designated areas, drip trays and spill kits will be made available at these designated refueling areas. All associated waste residuals will also be stored within temporary bunded storage areas prior to removal by an appropriate waste disposal contractor for off-site treatment/recycling/disposal. Any other building waste will be disposed of in on-site skips for removal by a licensed waste disposal contractor. Only emergency breakdown maintenance will be carried out on site. Appropriate containment facilities will be provided to ensure that any spills from vehicles are contained and removed off site. An emergency

plan to deal with accidental spillage will be drafted and kept on site during the construction period.

- All operations involving the loading and unloading of hydrocarbon products shall take place in the bunded area in such a manner as to avoid any pollution of waters. The bunded area shall be fitted with a locking valve to prevent discharge to storm water. The developer shall ensure that this valve is locked at all times.
- The appointed contractor shall undertake an inspection of the hydrocarbon storage areas on at least a weekly basis and shall maintain a register of the outcome of such inspections. The register shall be made available for inspection at all reasonable times.
- Fueling and lubrication of equipment will only be undertaken within the site compound.
- Any spillage of fuels, lubricants or hydraulic oils should be immediately contained and the contaminated soil removed from the site and properly disposed of.
- Oil booms and oil soakage pads should be kept on site to deal with any accidental spillage.
- Waste oils and hydraulic fluids should be collected in leak-proof containers and removed from the site for disposal or re-cycling.
- Prior to any works, ensure that all construction equipment is mechanically sound to avoid leaks of oil, fuel, hydraulic fluids and grease.
- Prior to the construction of the temporary site compound, all refueling and maintenance will be carried out off site.

4.5 CONSTRUCTION WASTE MANAGEMENT PLAN

This Plan has been prepared to manage waste arising during the construction phase of the project. In the case of the proposed development, waste material is generally likely to be limited to excess spoil as discussed above, waste water and waste oils etc. However, where construction activities and a full-time human presence occur, it is prudent to develop a Construction Waste Management Plan.

4.5.1 General Waste Management on Site

To manage waste effectively, focus on the following:

- Ordering the correct amount of materials to be delivered when needed;
- Ensuring materials are not delivered to site damaged and unusable;
- Reducing the amount of packaging used by suppliers;
- Where possible, establish a ‘take back’ system with suppliers;
- Ensuring wastes are handled and stored correctly; and
- Limiting the amount waste going to landfill by reusing and recycling where possible.

Waste arisings/recyclables and the system for their management during the construction phase are detailed below.

4.5.2 Recyclable Waste

This waste stream may arise from waste packaging of engineering components. A suitable container will be put in place for the collection of recyclable waste which will be located within the temporary site compound. Special care will be taken to insure that no green waste or food waste will be disposed of in this skip. This material will be taken to an appropriate location for disposal on a regular basis.

4.5.3 Mixed Waste

This waste will be collected in a suitable container within the site compound and will be removed off-site to an appropriate facility on a regular basis.

4.5.4 Waste Oil and Non Liquid Oily Waste

- Waste oil collection will be provided at a purpose built double skinned tank in the compound;
- All oil containers will be placed on covered bunds;
- Drip trays and funnels will be used when transferring any oils or fuel from one container to another;
- The collection of Non Liquid Oily Waste (e.g. rags and oil contaminated materials) will be segregated from mixed waste and placed in approved containers for shipment;
- These materials will be removed off-site regularly to an appropriate facility; and
- Oil Spill kits will be located adjacent to any areas where oil or lubricants are being used.

4.5.5 Waste Ferrous/Non Ferrous Metal

These materials will be collected within the site compound and segregated and disposed of off-site at an appropriate facility.

4.6 AIR AND DUST MANAGEMENT PLAN

4.6.1 Introduction

The proposed upgraded WTP is located within a rural landscape, with a number of farmhouses and one-off rural houses located along the regional road and local roads in the vicinity of the development site. The land-use is primarily agriculture where the lack of large scale industrial activity is likely to ensure good air quality. The site is in EPA Zone D (rural) in terms of air quality and demonstrates low background concentrations.

4.6.2 Potential for Impact

The primary potential source of air emission during the construction stage is dust. Dust from a construction site can cause annoyance to neighbouring residents, and therefore important to manage should dust become a cause for complaint. Increased levels of dust from the construction process could potentially enter the site's drainage channels continuing downstream to the Eighnagh River potentially impacting the water quality of this watercourse.

4.6.3 Best Practice Measures for the control of Airborne Pollutants during Construction Activities

To protect sensitive receptors in the vicinity of the scheme the following measures are proposed. Measures to mitigate the emission of dust due to construction activities include:

- Wind breaks and barriers;
- Control of vehicle access;
- Vehicle speed restrictions;
- Bed of gravel at site exit points to remove caked on dirt from tyres and tracks;
- Washing of equipment at the end of each work day;
- Prevention of on-site burning;
- Hard surface roads should be wet swept to remove any deposited materials;
- Unsurfaced roads should be restricted to essential site traffic only; and
- Wheel-washing facilities should be located at all exits from the construction site.

4.6.3.1 Construction Phase

The main construction related impact of the proposed development on water quality at the site is the release of sediments into watercourses. There is also a risk that sewage from site facilities or oils, cements or other construction materials may be discharged to a drain or watercourse.

The following best practice measures are proposed to reduce the impacts of construction of the proposed development on water quality: -

- Construction works will be planned outside of periods when heavy rainfall is expected;
- Site access roads should be allowed to consolidate, dry out and settle before use, so that they do not become rutted from traffic;
- Construction activities will be located away from existing watercourses. Where access routes pass close to watercourses and channels, silt fencing shall be used to protect existing water quality;
- Spoil heaps generated during construction should be deposited on stable areas away from aquatic zones. They should be levelled out where possible, or breached at 20 m intervals and seeded to encourage greening over and stabilisation;
- Soil stockpiles will be kept to a minimum. Where required, sediment control measures shall be implemented at each stockpile. Stockpiles will be surrounded by silt fences to filter sediment from the surface water run-off from excavated material. Sediment control features shall be inspected and maintained regularly to ensure their correct operation. Additional inspections and maintenance will be carried out when required e.g. extreme rainfall events;
- The contractor will include a formal procedure to deal with queries and comments from the general public in his emergency response plan. During the construction period, it is envisaged that a facility to shut off the outfall from the silt traps during an emergency will be provided. This will mitigate for any on site accidental spillage impacting on the watercourses. In addition,

appropriate signage should be placed on site outlining the spillage response procedure and a contingency plan to contain silt. Adequate security should be provided on site to prevent spillage as a result of vandalism. A regular review of weather forecasts of heavy rainfall is required and the contractor will prepare a contingency plan for before and after such events;

- The contractor shall ensure that all personnel working on site are trained in pollution incident control response;
- The construction of roadside drainage channels for access track drainage will follow the natural flow paths on site where possible. Where possible, existing overland flow channels will be maintained. This will reduce effective slope, run-off velocities and any consequent potential for erosion;
- The contractor shall ensure that sedimentation control and dispersal facilities are regularly maintained during the construction phase;
- Trafficking on site shall be kept to a minimum and where possible kept away from existing watercourses and channels. Where access routes pass close to watercourses and channels, silt fencing shall be used to protect existing water quality;
- All chemicals, hydrocarbons and other deleterious materials will be stored within the site compound;
- All maintenance and refuelling operations and machine repairs (if required and practical) will be completed within the site compound;
- All fuel and machine oils will be stored in bunded areas, within the site compound.

The competent authority, Local Authority and IFI will be notified immediately of spillages or other accidents during construction which threaten aquatic zones. All operators should have contact telephone numbers onsite for all relevant agencies (Local Authorities, NPWS, Garda Síochána, etc.) in case of accidental damage to aquatic zones, important wildlife habitats and other environmental features.

4.7 TRAFFIC MANAGEMENT

4.7.1 Introduction

An impact on local traffic could potentially arise during the temporary construction phase, in particular works adjoining the R294 footprint and delivery/removal of material to the site and the removal and the potential removal of spoil off-site. Mitigation measures are therefore proposed.

4.7.2 Mitigation Measures

Should it be required by the competent authority, prior to the commencement of construction, a fully detailed CTMP will be prepared by the appointed Contractor and submitted to the competent authority for approval.

The CTMP will include all relevant best practice measures to include:

- In order to minimise the level of construction traffic all materials where possible will be sourced locally;

- Machinery deliveries and construction vehicle movements to the site will be scheduled so as to spread the arrival and departures of construction vehicles over the day and avoid peak traffic on the local road network;
- During the construction of the access road, the delivery of material to the site will be restricted to non-peak hour traffic in order to minimise disturbance to local road users; and
- Should the local authority require it, both the local authority and road users will be notified of the dates and times that material will be transported to the WTP site.

4.8 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

4.8.1 Introduction

The purpose of this Construction Noise and Vibration Management Plan is to:

- Minimise the impact of noise and vibration associated with the Project;
- Protect the amenity of residents and other building occupiers; and
- Prevent damage to adjacent public utilities, structures and buildings resulting from vibration.

4.8.2 Mitigation Measures Noise

Standardised noise pollution mitigation measures will be implemented during all stages of construction these measures have been set out below:

- All works at the watercourse should make a 'short-start' to activities to allow in-situ and proximal fauna to move away before the full intensity of works begins;
- Work will be undertaken during daylight hours, starting no earlier than two hours after dawn and finishing no later than two hours before dusk, between March and October; and to start no earlier than one hour after dawn and finish one hour before dusk from November to February; and shall not continue for periods of more than 12 hours, to prevent disturbance to nocturnal species.

British Standard *BS5228:2009 – Noise and vibration control on construction and open sites* outlines a range of measures that can be used to reduce the impact of construction phase noise on the nearest noise sensitive receptors. These measures should be applied by the contractor where appropriate during the construction phase of the proposed development. Examples of some of the best practice measures included in BS5228 are listed below:

- Ensuring that mechanical plant and equipment used for the purpose of the works are fitted with effective exhaust silencers and are maintained in good working order;
- Careful selection of quiet plant and machinery to undertake the required work where available;
- Machines in intermittent use should be shut down in the intervening periods between work;
- Handling of all materials should take place in a manner which minimises noise emissions;
- Audible warning systems should be switched to the minimum setting required by the Health & Safety Executive;

- A complaints procedure should be operated by the Contractor throughout the construction phase; and
- Toolbox talks shall be carried out with all staff prior to commencement of works to highlight and identify issues relating to noise and vibration generation and mitigation.

4.9 SITE AND ENVIRONMENTAL PROCEDURES

The Main Contractor shall have a management team in place on site to oversee and co-ordinate the construction activities at the site.

The following (minimum) project specific procedures will be developed and employed by the contractor and their subcontractors for each environmental aspect while working on the project.

Outline of Potential Environmental Procedures:

Procedure Area

ENV-01 Awareness & Training

ENV-02 Environmental Emergency Response

ENV-03 Record Keeping, Auditing and Monitoring

ENV-04 Erosion Control

ENV-05 Environmental Complaints Procedure

ENV-06 Protection of Flora and Fauna

ENV-07 Protection of Water Quality

ENV-08 Protection of Archaeological Heritage

ENV-09 Protection of Landscape

ENV-010 Traffic Management Plan

ENV-011 Management of Excavated Material

ENV-012 Noise Management Plan

ENV-013 Air Quality Management Plan

ENV-014 Waste Management Plan

ENV-020 Invasive Species Management Plan

These procedures are included in this document for illustrative purposes. The Contractor will be responsible for formulating these procedures, and may wish to amend these procedures when appointed. These procedures will form part of the CEMP, and will be continually updated where necessary.

These procedures can only be amended by improvement with regards to environmental protection and must take cognisance of all mitigation measures recommended by the NIS and associated technical reports.

4.10 SITE REINSTATEMENT PLAN – POST CONSTRUCTION

4.10.1 Introduction

This Site Restoration Plan describes methods for the restoration of areas temporarily disturbed during the construction phase of the proposed WTP upgrade. The objective of this plan is to restore temporarily disturbed areas in line with the proposed construction works. The appointed Contactor will be responsible for the implementation of site reinstatement measures outlined within this plan.

4.10.2 General Site Remediation

The site is proposed to be landscaped and fenced in a manner that adequately secures the site while not severely impacting on the rural landscape. It is proposed that the overall site development shall be sensitively assimilated into the agricultural landscape.

The site is proposed to be landscaped and fenced in a manner that adequately secures the site while not severely impacting on the rural landscape. It is proposed that the overall site development shall be sensitively assimilated into the agricultural landscape.

4.10.3 Fencing

The boundary of the existing WTP site consists of a rubble stone wall which will be retained. The existing natural front boundary of the extended site including low earth mound and drainage ditch, will be maintained as far as possible. The treatment plant will be secured behind 2.4m high dark green mesh wire security fencing.

4.10.4 Landscaping

It is proposed that the grassed areas of the site would be planted with a grass and wildflower seed mix in order to permit less maintenance of these open areas and encourage a natural looking, less cultivated meadow.

It is proposed that the screening trees proposed around the site will be drawn from the list in **Table 2.1**. The trees will be planted at 1.5m spacing and will be minimum 2.5m tall when planted.

Table 2.1: Screening Tree Species

Tree Species	Latin name	Notes	Specification
Common ash	*Fraxinus excelsior*	Moderate growth rate - slender bole until maturity	Standard: Root Balled Tree, height of 250-300cm, girth 8-10cm
Alder	*Alnus glutinosa*	Moderate growth rate - Suited to poor draining soils	Standard: Root Balled Tree, height of 250-300cm, girth 8-10cm
Birch	*Betula pubescens*	Good growth rate. Low canopy trees to 5m, slender bole. Widely used in landscape planting	Standard: Root Balled Tree, height of 250-300cm, girth 8-10cm
European mountain ash	*Sorbus aucuparia*	Similar properties to birch. Will establish poor draining / peaty soils	Standard: Root Balled Tree, height of 250-300cm, girth 8-10cm
Field Maple	*Acer campestre*	Non-native. Small / low canopy trees often used for understory layer filling.	Standard: Root Balled Tree, height of 250-300cm, girth 8-10cm

The trees will be planted at 1.5m spacing and will be minimum 2m tall when planted.

4.10.5 Reinstatement Measures

With regards to effective reinstatement of the surrounding environment involved in the works, the following measures should be applied and adhered to.

- No permanent spoil or stockpiles will be left on site. It is proposed that all onsite stockpiles of spoil will be removed and either spread on site or removed off site for use elsewhere in line with the proposals contained in the **NIS**;
- The appointed contractor shall clean-up all areas affected by construction operations. That will include removal of all plant, equipment and materials not required for maintenance and monitoring works; and
- Vegetation re-colonisation will be monitored and managed if necessary by an environmental engineer or ecologist. Natural re-vegetation is the preferred method of recovery. However, where required (for example, where adequate quantities of vegetated sod are not available), seed mixes of native local provenance will be sourced to engender semi-natural grassland regrowth within the study area.

5 MONITORING

5.1 OBJECTIVES

This section sets out to identify and summarise previously discussed specific monitoring activities required in order to ensure optimal environmental performance throughout the construction phase. The Contractor should note that these are specific monitoring requirements and the Contracts Project Manager is to ensure that all the requirements of this CEMP are adhered to for the duration of the construction works by carrying out regular inspections.

5.2 MONITORING REQUIREMENTS

Environmental Audits must be carried out on site. The auditing requirements include but are not limited to the following:

- Public access roads – The condition of the public roads in the vicinity of the development site shall be inspected daily by site management to ensure that the roads are in a safe and passable condition. Where necessary, potholes and road surface shall be filled in and surfaces made good where necessary. Roads will be cleaned as necessary;
- Water quality monitoring will be required to be carried out on site, including daily visual inspections by a suitably qualified environmental engineer, and weekly audits;
- During the construction phase of the project, the detailed Surface Water Management Plan for the site will identify each silt control feature with a reference number and an on-site quality system of maintenance and monitoring of each trap will be implemented. Compliance will be monitored in the form of an Audit checklist and results made available to IFI, NPWS, Sligo County Council and Irish Water if requested;
- Drainage and water crossings - similar to above for impacts to watercourses will be monitored to ensure that the best practice and mitigation measures proposed in the NIS are implemented and that the conservation interests of the designated sites are effectively protected during the construction phase of the works; and
- Contractors compound to be monitored for appropriate storage of materials and appropriate adherence to recommended practices.

5.3 REPORTING AND AUDITING

5.3.1.1 General

The avoidance, control and mitigation measures outlined in this document will ensure that sediment and other deleterious materials arising from the works will be controlled and minimised. They have been developed in accordance with best practice, and have been shown to work on other projects. As with all systems, there is a requirement to have monitoring, audit and feedback loops to demonstrate the operation of the system. Construction stage monitoring will be carried out by the Contractor and an Environmental Officer to be appointed by the contractor.

- The contractor will be obliged to hold a training talk or 'Toolbox Talk' on the EOP for all site staff immediately before works commence on site. The subject of this course shall be the measures that have been put in place to protect the environment and the procedures and monitoring and recording that is to be undertaken in accordance with the EOP;
- Environmental Checklists shall be prepared for each operation. Responsibility for completion of these checklists will be assigned to individual members of the contractor's staff. The following operations will also require a Permit-to-Work before operations can commence each of which must be counter signed by the Environmental Officer:

  a) Completion of sediment removal facilities prior to initial discharge to watercourse
  b) Restart of works following any pollution incident

- All environmental monitoring and checklists shall be recorded and added to the EOP on a daily basis;
- The EOP shall assign particular responsibility and monitoring duties to particular named staff and the Site Agent/ Manager shall ensure that this is implemented in full. Training for each member of staff on their specific area of responsibility shall be carried out before the commencement of that operation. A record of all training carried out shall be maintained in the EOP and a further copy issued to the EAO;
- All mitigation/ control measures shall be inspected daily by designated contractor staff and maintenance and repairs carried out immediately; and
- Any direct release of sediment to a watercourse causing plumes shall be stopped immediately, emergency procedures shall be initiated and the Environmental Officer staff notified immediately. Appropriate corrective measures to avoid any repetition shall be put in place.

5.3.1.2 Environmental Officer (EO)

Separate from the on-going and detailed monitoring carried out by the contractor as part of the EOP; the Environmental Officer (EO) shall carry out the inspection/ monitoring regime described below on behalf of the employer. The results will be stored in the EO's monitoring file and will be available for inspection/ audit by the competent authority or requisite environmental bodies.

- Inspect all best measures as detailed in the NIS and in this CEMP on a weekly basis. Report findings to the Contractor;
- Inspect surface water treatment measures (ponds, tanks, mini-dams, sandbags, etc.) on a daily basis;
- Stockpiles shall be monitored on a daily basis while being filled or emptied and otherwise on a weekly basis;
- Control measures for works at or near water bodies shall be inspected on a daily basis;
- Concrete operations at or near watercourses shall be supervised and designated chute washing out facilities shall be inspected on a daily basis;
- The attenuation pond & silt trap and the efficacy of silted water attenuation and release system will be inspected on each site visit and especially during pumping of water and during or after heavy rainfall events;

- The site compound shall be inspected on a weekly basis; and
- The Contractor's CEMP monitoring results shall be audited on a frequent basis (weekly at a minimum).

5.3.1.3 Pollution Event Response Strategy

Where the EO has carried out an investigation of a release of sediment or other pollutant such as hydrocarbons or concrete to a watercourse causing a plume, the following procedure shall be followed:

- The discharge generating the pollutant release shall be stopped immediately;
- The contractor will be required to take immediate action and to implement measures to ensure that such discharges do not re-occur;
- Works shall not recommence until appropriate corrective measures to avoid any repetition are put in place. Such measures shall be in accordance with the requirements of this CEMP;
- Where the discharge is from one of the control measures associated with the works the controlled discharge shall not recommence until written consent is received from the EO;
- Where the EO considers that the risk of a sediment release is high, he/ she shall inform the contractor and request protective action to be taken. Where the contractor does not take immediate action the EO shall instruct the contractor to take action and same shall be reported to the Contract Manager and the Client; and
- The EO will be delegated powers under the contract sufficient for these instructions to be issued and for an instruction to stop works or carry out emergency works.