Groundwater Risk Assessment

H Westons & Sons Ltd.

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SITE DETAILS

H Weston and Sons Ltd

The Bounds

Much Marcle

Ledbury

HR8 2NQ

OPERATOR DETAILS

H Weston and Sons Ltd

The Bounds

Much Marcle

Ledbury

HR8 2NQ

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APPENDICES

REFERENCE	TITLE
Appendix A	Appendix A_GW RA_BGS borehole 19289691 (SO63SE4)
Appendix B	Appendix B_GW RA_BGS borehole 19367598 (SO63SE5)
Appendix C	Appendix C_Reservoir engineers report Dec2024

1. INTRODUCTION

This document is a Groundwater Risk Assessment produced for the permit application for the pressing of apples, the production of Cider and the treatment of factory derived effluent at the on-site Waste Water Treatment Plant (WWTP) at The Bounds, Much Marcle, Ledbury, HR8 2NQ. The site is located at National Grid Reference SO 6433 8714.

The site has been producing Cider in the same location since the late 1800's but are now over the Environmental Permitting thresholds and require a permit to continue operating.

The application has been prepared by Wiser Environment Limited on behalf of the applicant H Weston & Sons Ltd, company number 00672234.

This assessment evaluates the risk to groundwater from the Long Meadow Wetlands (constructed wetland / reservoir) used by H. Weston & Sons Ltd for secondary treatment of wastewater prior to controlled irrigation of orchards. The wetlands are a series of interconnected ponds, earth/woodchip banks and planted treatment zones, and are recognised as a reservoir under the Reservoirs Act 1975, with statutory supervision and safety monitoring.

1.1. Aims

The aim of this document is to provide the Environment Agency with sufficient evidence on the risks posed by the wetland system to the groundwater.

2. ENVIRONMENTAL SETTING

2.1. Hydrogeology

A secondary A superficial aquifer is located 106m N of the site. Described as a permeable layer capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

There are source protection zones within the site: Source Protection Zone 3 (total catchment) and Source Protection Zone 2 (outer catchment).

There are 6 records of bedrock aquifers within 500 m of the site.

Two secondary A aquifers are found on site, and one secondary A aquifer is found 187 m S of the site. Secondary B aquifers can be found on site, 173m S and 247 m S of the site.

Four boreholes are located 250 m from the site. These include Westons Cider Factory, Much Marcle, 28m N (NGR 365130 233490), Westons Cider, Much Marcle, 46m W (NGR 365100 233300), Westons Cider, the Cricket Pitch, Much Marcle, 49m N (NGR 365100 233500) and Westons Cider, Factory Much Marcle, 100m N (NGR 365180 233560).

2.2. Geology & Hydrogeology

4 boreholes are located 250 m from the site. These include Westons Cider Factory, Much Marcle, 28m N (NGR 365130 233490), Westons Cider, Much Marcle, 46m W (NGR 365100 233300), Westons Cider, the Cricket Pitch, Much Marcle, 49m N (NGR 365100 233500) and Westons Cider, Factory Much Marcle, 100m N (NGR 365180 233560). Two of the boreholes are shown in APPENDIX A and B.

The BGS borehole logs show the following stratigraphy:

- surface brown/light brown clays and sandy clays with gravels,
- underlying red clay marl / mudstone, and
- sandstone/mudstone sequences at depth.

These upper clay/marl units are low permeability, providing a natural attenuation barrier to vertical migration.

2.3. Hydrogeology

A secondary A superficial aquifer is located 106m N of the site. Described as a permeable layer capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

There are 6 records of bedrock aquifers within 500 m of the site.

Two secondary A aquifers are found on site, and one secondary A aquifer is found 187 m S of the site. Secondary B aquifers can be found on site, 173m S and 247 m S of the site.

There are source protection zones within the site: Source Protection Zone 3 (total catchment) and Source Protection Zone 2 (outer catchment).

3. WETLAND SYSTEM DESCRIPTION AND MAINTENTANCE

The Wetlands comprises of a series of earth-banked ponds that run in sequence, with the aim of physico-chemically and biologically treating wastewater through plant root systems and aerobic and anaerobic bacteria that colonise the ponds and planted soil banks.

The influent entering the wetland system is the pretreated cider effluent that has already undergone full BAT complaint treatment at the site's Wastewater Treatment Plant (WWTP) which comprise of DAF, MBR and aerobic steps.

The wetlands are an additional stage designed to prepare the water for irrigation of the orchards, as wetlands waters provide nutrient value to the orchard and avoids the need for the use of chemical fertilisers.

WWTP-pretreated cider effluent enters Pond 1 and flows slowly through a plug-flow chain of planted ponds and soil/woodchip filtration banks. Dense stands of willow, alder, reeds and rushes create an active root-zone where diverse microbial communities mineralise and oxidise organic matter, driving major COD reduction. Evapotranspiration lowers hydraulic load and increases residence time, while ammonia volatilisation removes part of the nitrogen directly. Remaining nitrogen is sequentially transformed by microbes through ammonification, nitrification in aerobic root microsites, and denitrification in anoxic saturated soils, releasing inert nitrogen gas; phosphorus and other nutrients are captured into plant biomass and soils and removed through routine harvesting/maintenance. As the ecosystem matures, rooting depth and microbial diversity increase, improving treatment efficiency. The final ponds provide polishing and storage, and the treated water is then applied to orchards by controlled drip irrigation as a beneficial reuse.

The wastewater flow is not permanently directed to the wetlands. Flows are controlled manually. Times where wastewater discharges will be directed to the wetlands are:

Orchard irrigation water preparation.

Breakdown or poor performance of the existing WWTP (i.e., only contingency, in case of emergency).

Where generation of excess effluent occurs, it will be directed to the wetlands for a temporary period for flow balancing.

The wetlands are recognised as a reservoir under the Reservoirs Act 1975, as such they are subject to annual inspections by reservoirs engineers. Appendix C shows the latest from 2024.

The inspections check for the following elements:

- Embankment vegetation: cut saplings/hedges; pollard trees; keep grass short. Prevents root seepage paths and keeps faces inspectable.
- Toe ditches & west ditch: clear all toe ditches; cut west ditch banks short; keep 2 m² cross-section. Maintains drainage capacity and seepage detection visibility.
- Spillway/overflow route: keep downstream channel clear to 3 m beyond 5 m width; reseed grass. Preserves flood capacity and prevents erosion/overtopping
- Overflow approach: remove scrub/saplings; encourage short grass. Prevents blockage and erosion at critical control structure.
- Crest surface: repair rutting; reseed or hard-surface if trafficked. Maintains crest integrity and access for inspection Detailed 2024 maintenance suggestions
- Monitoring kit: upgrade gauge board; define survey pin datum; repair pins. Ensures reliable safety records and settlement tracking.

4. RISK ASSESSMENT PRINCIPLES

The risk assessment has been developed based on the identification of source-pathway-receptor linkage.

In developing a conceptual site model for the end uses linkages are determined by identifying potential sources of contamination, potential receptors and likely pathways between them:

- The **source** of potential contamination is the water discharge into the wetland system.
- The **pathways** are routes by which the water can travel and reach the receptors. In this case the main pathway is the seepage of water in the soil underneath the wetland system, which can reach water the aquifer.
- The **receptors** are those adversely affected by the contamination. In this case the groundwater, potentially affecting drinking water and the ecology.

4.1. CONCEPTUAL SITE MODEL

The important considerations in estimating risk to groundwater are the definition of sources area, the path between source and groundwater and likely infiltration rate (low or high).

- **Source area**

The area identified as the source of potential contamination is the area covered by the wetland pond system.

- **Pathway**

The infiltration rate of the water through the soil is controlled by the characteristics of the soil, made ground, rock and other materials that may be present between source and receptor. Other properties such as soil thickness, drainage and topography also control the infiltration rate.

In this specific case the site is underlain by natural low-permeability clays/marls. The depth of the clay strata beneath the site can be estimated by analysing the BGS borehole logs. The logs suggest that there is a considerable layer of low-permeability clay between the water at the surface and the groundwater.

The layer of low impermeability clay constitutes a path between the wetland water and the groundwater, which can be defined as the mixing zone and would provide attenuation of the concentration of the contaminants potentially present in the water.

- **Receptors**

Both boreholes record artesian conditions / water strikes at depth, indicating confined groundwater systems beneath the low-permeability strata.

The principal groundwater receptors are confined and protected by low-permeability superficial deposits, so any shallow seepage would be strongly attenuated before reaching an aquifer.

5. CONCLUSION

According to a document from the BGS borehole records and reservoir supervising engineer statements, the wetland system presents a low residual risk to groundwater primarily because of the natural attenuation provided by the thick, low-permeability clay sequence beneath the reservoir.

The two nearby BGS boreholes show that the wetlands are underlain by brown/light brown clays and sandy clays with gravels at shallow depth, followed by red clay marl and then extensive mudstone/sandstone units. These clay and clay-marl horizons are characteristically very low in permeability and act as an effective aquitard, greatly restricting vertical seepage and providing strong filtration and sorption capacity for any residual dissolved contaminants.

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