

*Lessons learnt from
Marlfield Farm*

Paul Millard





Leeds FAS2 Natural Flood Management

Marlfield Farm (Earby)

The role of detailed engineering design in planning and delivering NFM

Paul Millard – Senior Flood Risk Engineer (Mott MacDonalD)

NFM CoP 2022.10.19



Agenda

- **Introductions (MM Design Team)**
- **Project Background**
- **Development Lifecycle**
- **Lessons Learned**
- **Questions / Discussion**



The Leeds Natural Flood Management (NFM) project is the Environment Agency's largest NFM project, and will enhance the climate resilience of Leeds Flood Alleviation Scheme, by offsetting the predicted impacts of climate change up to 2069, equivalent to reducing peak flood flows in the 0.5% (1 in 200 year) flood event by 5%

The **Flood Alleviation Scheme (FAS)** in Leeds will reduce the risk of flooding from the River Aire, however climate change is predicted to increase the frequency and magnitude of flood events



1946



1947



2000



2004



2007

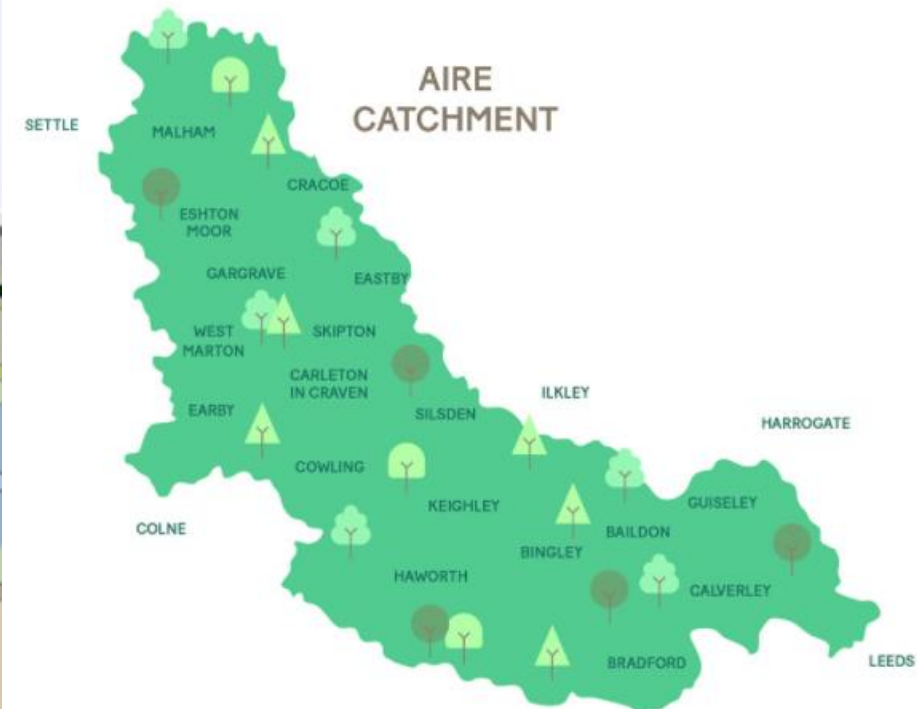


2008



2015

NFM is a catchment wide, low carbon, nature based solution to complement traditional flood risk management techniques, slowing and storing flood water upstream of the Leeds FAS



The project aims to **plant 2 million trees and improve soil health throughout the 700km² catchment**, to extend the standard of protection of the Leeds FAS between 2039 and 2069

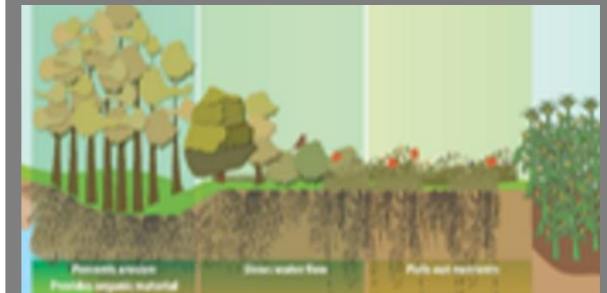
Catchment Woodland



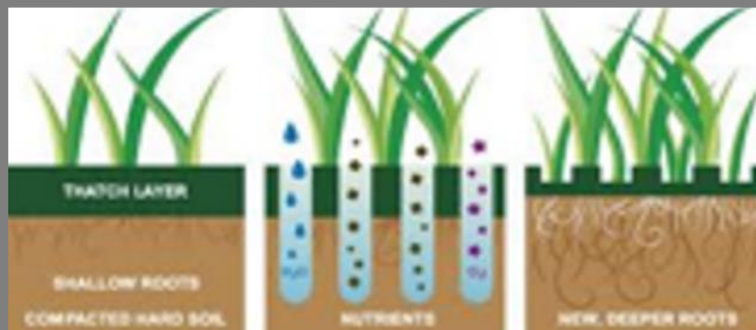
Floodplain Woodland



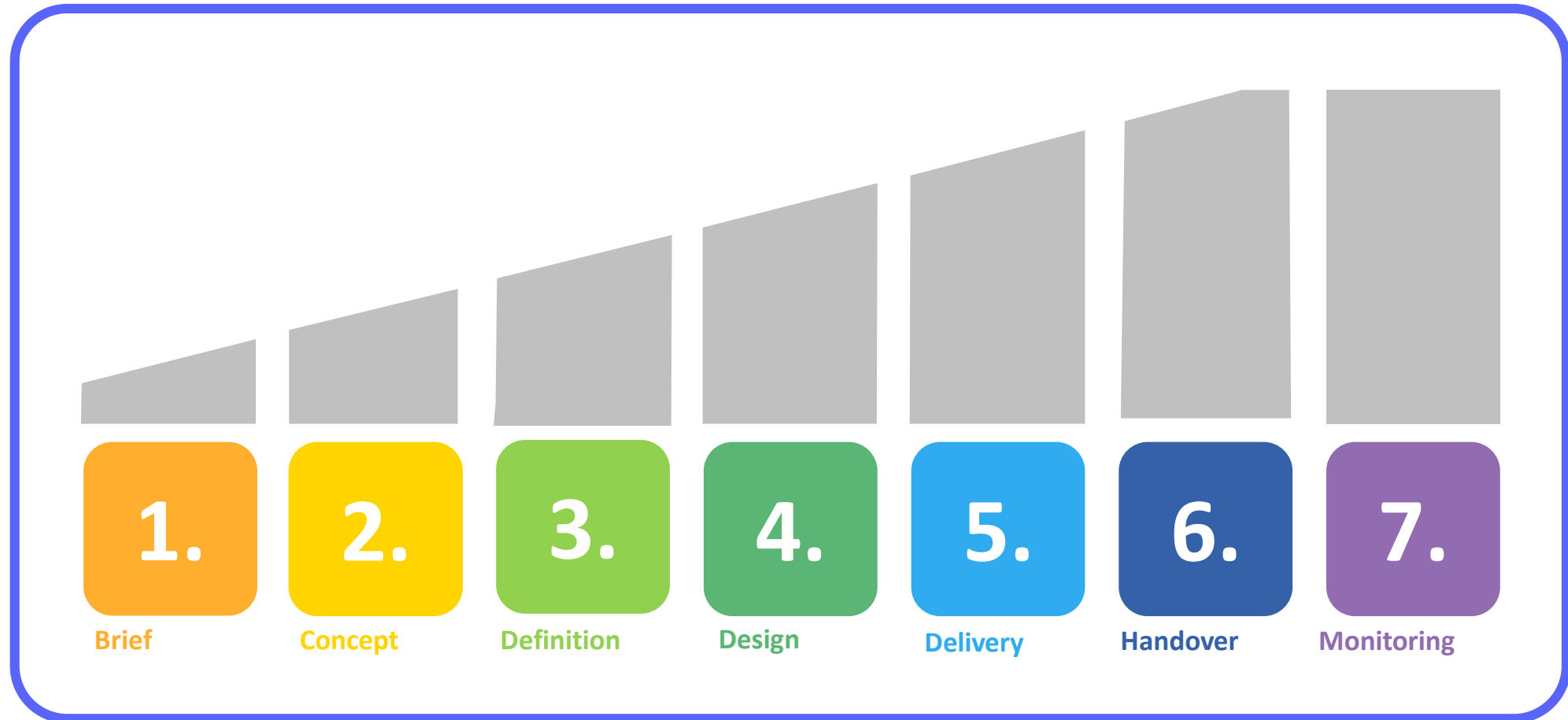
Buffer Strips



Soil & Land Management inc. Hedgerows



Environment Agency – Project Development Lifecycle:

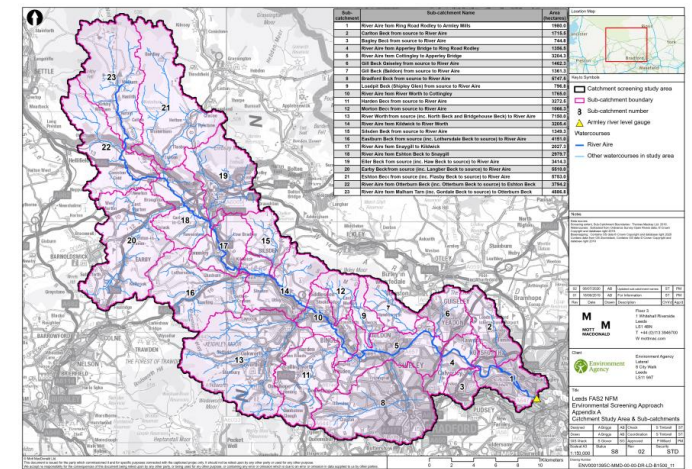
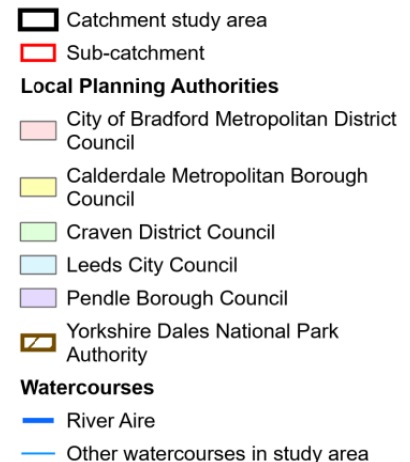
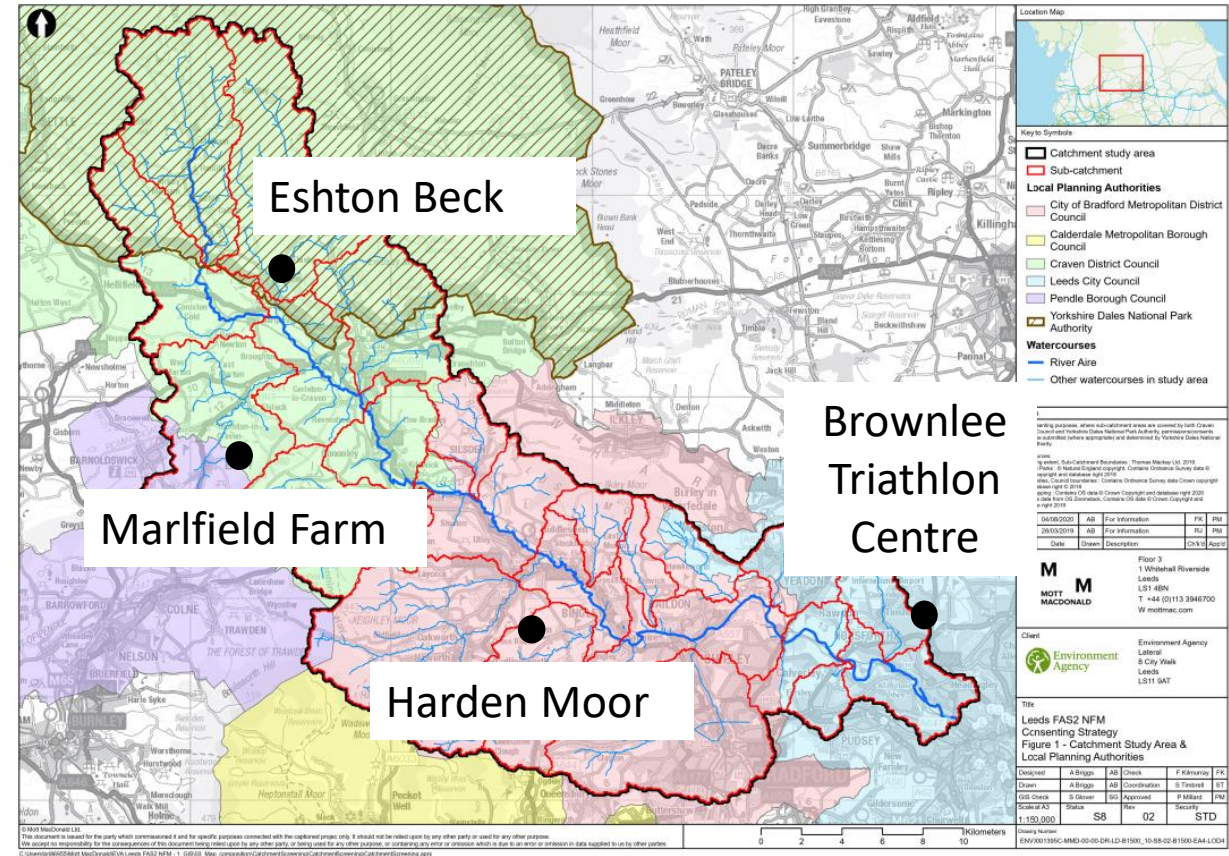


1. Brief



Key Challenges

- **Timescales** – need for early action – pilot sites
- **Scale** – massive catchment – need different people to engage in different locations – NFM Sites single source of truth
- **Language** – both in terms of how we engage and how we are consistent– what do we mean by a buffer strip?
- **Focus** – Can't deliver everything at once everywhere – developed process to screen/prioritise



Procter Family

Daniel & Heather Procter, son Rowan, and parents Howard and Lynda



ME Home Our Story Shop Blog Webcam Contact

A little piece of England on the Yorkshire / Lancashire border

Welcome to Marfield Farm; a small working hill sheep farm on the border of Yorkshire and Lancashire, just outside the Yorkshire Dales National Park. It's been the home to the Procter family for over 100 years, and in that time, we're proud to say that not much has changed!



Rare Breed Sheep For Sale



Biodiversity & Conservation at Marfield Farm



Marfield's Zero Carbon Footprint

Welcome to Marfield Farm...

Marfield Farm is home to a small flock of rare and primitive native sheep including the UK's rarest breed of sheep, the Hebridean, and the second rarest breed of sheep the North Ronaldsay as well as Soay, Shetland and other breeds. The Hebridean and North Ronaldsay breeds originate from the islands of Scotland and are famous for their unique characteristics and ability to thrive in harsh conditions. We breed and explore the history of these breeds.

We sell breeding stock of these breeds so if you're interested in starting your flock of Hebridean, North Ronaldsay, Soay or Shetland sheep, please do get in touch and we will be happy to help.

Did you know that Marfield Farm is also home to LambWatch which has been live streaming life

100 years

marfieldfarm.co.uk



25 acres of new and mature woodland at Marfield Farm, a large portion of this was planted in 2008

MAGIC

Table of Contents

- Habitats and Species
- Land Based Schemes
 - Agri-Environment Schemes
 - Forestry and Woodland Schemes
 - English Woodland Grant Scheme (England)
 - Woodland Trust Sites (GB)
 - Woodland Trust Sites (GB)
 - Woodland Trust Sites (GB)
 - Forest Plans (England)
 - Felling Licence Agreements (England)
 - Woodland Grant Scheme 1 (England)
 - Woodland Grant Scheme 2 (England)
 - Woodland Grant Scheme 3 (England)
 - Dedication (England)
 - Other Schemes
- Landscape
- Marine
- Aerial Photography
- Background Mapping
- Base Map

Coordinates: (31)449,447512 Grid Ref:SD9444751

Lessons Learned

- **4 Pilot Sites** – to test range of delivery approaches, delivery organisations and different landowners / types of site
- **Farm Scale Pilot** – Marlfield Farm was the only pilot site on a traditional working ‘family farm’
- **EA Delivery led** – works to be led by agency using in-house staff and framework suppliers

2. Concept



2. Concept

Concept Design:

“conception of the solution, typically a sketch showing initial idea for design, with broad outline of function and form”

2. Concept



Jenny Barlow

EA Flood Risk Adviser



Environment Agency

Natural Flood Management Measures – a practical guide for farmers



YORKSHIRE DALES National Park

one of Britain's breathing spaces



In-channel barriers

A network of in-channel barriers installed on a local scale can control channel flows. The dams are created to be slowly leaky, storing the trapped water once the flood period has passed. In-channel barriers could reduce the 1 in 100 year flood peak by 20%. Dams can be constructed so that floodwater spills onto the floodplain for additional temporary storage where conditions are suitable.

Natural flood management purpose

A network of in-channel barriers installed on a local scale can control channel flows. The dams are created to be slowly leaky, storing the trapped water once the flood period has passed. In-channel barriers could reduce the 1 in 100 year flood peak by 20%. Dams can be constructed so that floodwater spills onto the floodplain for additional temporary storage where conditions are suitable.

Agricultural benefits

Dams can successfully reduce localised flooding within the farm holding.

Construction dimensions

Large woody dams are created by laying two large tree trunks in a cross formation across the channel to rest safely on both banks, wedged in position. Smaller timbers can be wedged in place between the larger ones. Leaky dams are constructed by securing a support across the channel and securing slats, either horizontally or vertically to form a discontinuous barrier. Varying the height of the timber above normal flow will determine the rate and volume of retained floodwater. This will also permit fish passage.

Considerations

Many barriers are likely to be needed in a catchment and their implementation will need careful planning to make sure that the overall pattern of flood flows is not altered as this can cause flood peaks to coincide. Debris bundles can also be constructed in wooded areas to further roughen the surface of the floodplain and trap overland flows. Removal of sediment and re-spreading to land will require a waste exemption license from the Environment Agency (EA).

Level of maintenance

Large woody dams will need periodic checking to ensure the logs are still wedged in the right position. Periodic clearance of debris from the leaky dams will prevent blockage and overflow of water.

Key locations

Generally suited to smaller watercourses and ditches throughout the catchment, where holding water back is not going to create additional problems. Steep woodland in the upper catchment, recommended to be implemented alongside runoff attenuation features – for example, undersowing planting. Can also be located within fields on overland flow pathways.

Costs

Set-up	Low
Maintenance	Low

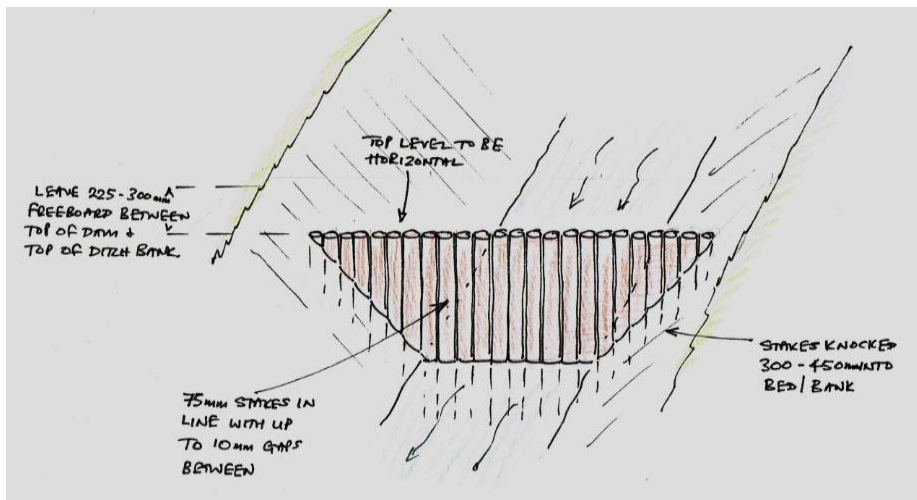
Funding

Countryside Stewardship (CS) scheme
Local Rivers Trusts (LRT) within project areas.

Additional information

Slowing the flow at Pickering
www.foresry.gov.uk/pdf/FR_STF_Pickering_P2_May2015.pdf

2. Concept



Don Vine

YWT Conservation Officer



Yorkshire

Naturally Resilient
Natural Flood Management techniques

Leaky Dams **Slowing the Movement of Water**

Figure 1. Naturally occurring dams

Description

Leaky dams occur naturally when large sections of trees fall into, and across the channel, holding back water during high flows. We can replicate these processes by building 'Leaky Dams', using a variety of different methods that utilise locally sourced wood, securely pinned in place.

Design

There are several different types of leaky dams, this guide focuses on three different structures: Wedged Log Leaky Boards and Natural dams. All three are effective at slowing the movement of water during high flow events.

There are a few key rules to follow when installing any leaky dams:

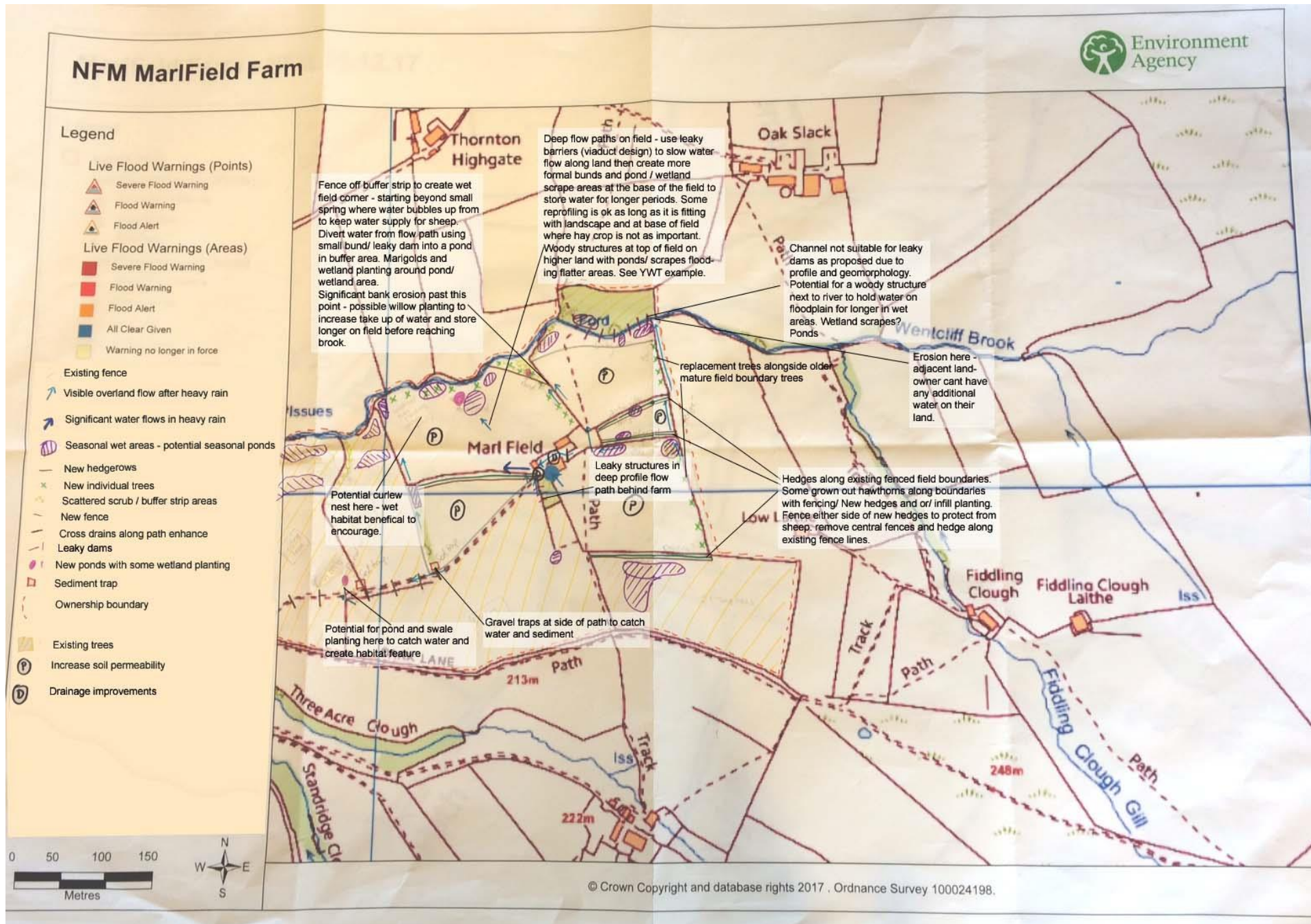
1. They must be installed, at a minimum, in a sequence of 3.
2. The distance between each dam should be 7 times channel width.
3. The width of the dam should be 1.5 times channel width.
4. The structure should be set 300mm above base flow level.
5. Logs should be no more than 400mm in diameter.
6. Where possible, materials should be sourced locally.
7. Structures should be installed 90° to the flow.
8. *

PLAN VIEW

CROSS SECTION

Figure 2. Key rules for leaky dams

2. Concept



Lessons Learned

- **Landowner led** – Working farm is an extension of their home/garden, so concept needed to be carefully considered and discussed with all Procter family members (using their knowledge of flood pathways).
- **NFM / Rural SuDS** – farmland setting, keen to use farmland materials (different from NFM used in woodland setting or on heath/moorland).
- **Demonstration Site** – Keen to trial/test a range of NFM measures, even though may not be most effective due to site constraints.
- **Wentcliff Brook** – watercourse was initially considered for leaky barriers but discounted following site visit by EA specialist as high energy watercourse (stone bed, steep gradient and fast response catchment) and also joint boundary with third party/neighbour.

3. Definition



3. Definition

Design Definition:

“The preliminary design, or high-level design, often bridges a gap between concept design and detailed design”

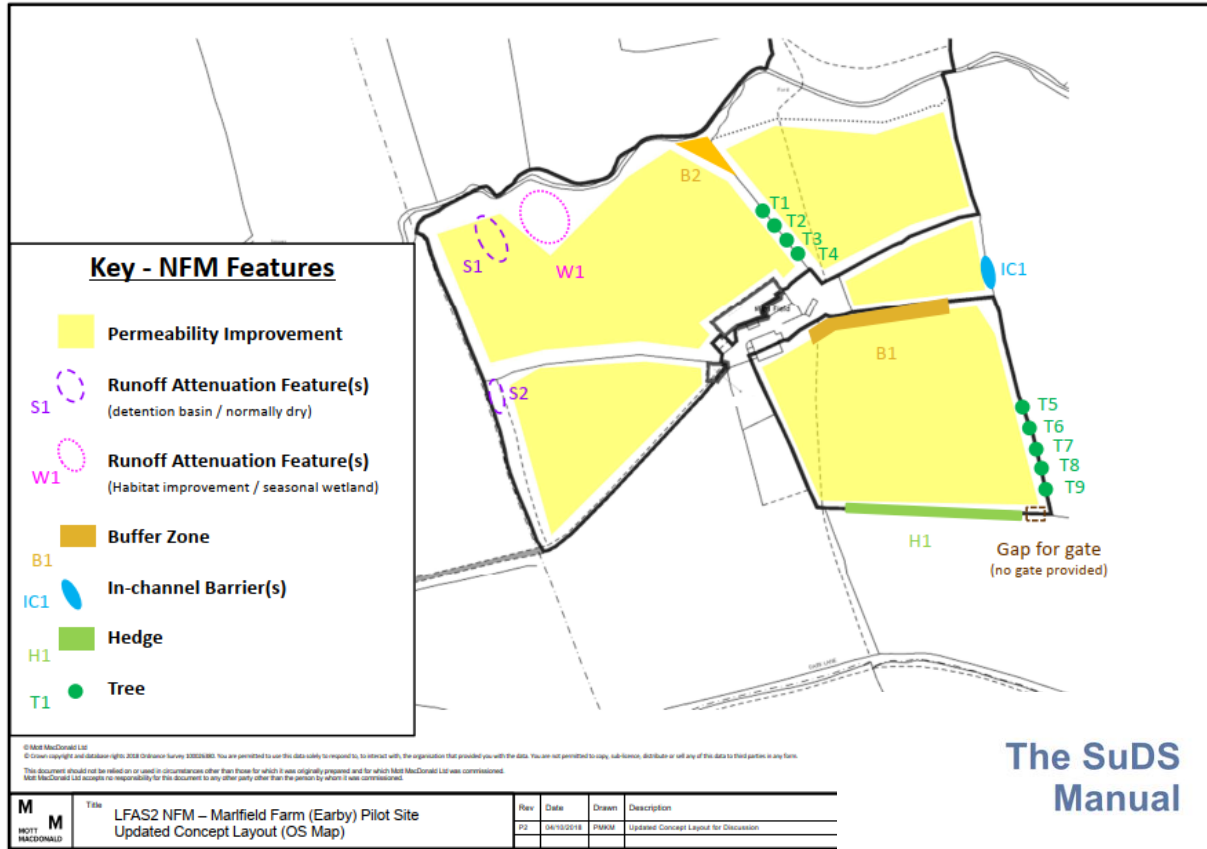
Note: where one phase ends and the next phase begins can vary from project to project

Preliminary Design - Introduction

- **Preliminary Design Purpose**
 - Clarify details from concept design based on site constraints/surveys
 - Drawings suitable for pricing/cost estimation by Framework Contractors
 - Enable consultation with planning authority / stakeholders (planning permission not required)
- **EA Construction Design and Management (CDM) Process**
 - EA Principal Designer appointed and HSE Notified (F10 Form)
 - CDM Stop-Go Checklist: PSRA and Buildability Statement
 - SHEW CoP and Hazard Maps
- **0.5% AEP Event (1 in 200 year flood) + Climate Change to 2069**
 - Constructed NFM measures need to be 'robust'
 - Target 50+ year design life (min 20 years)

3. Definition

Design Development

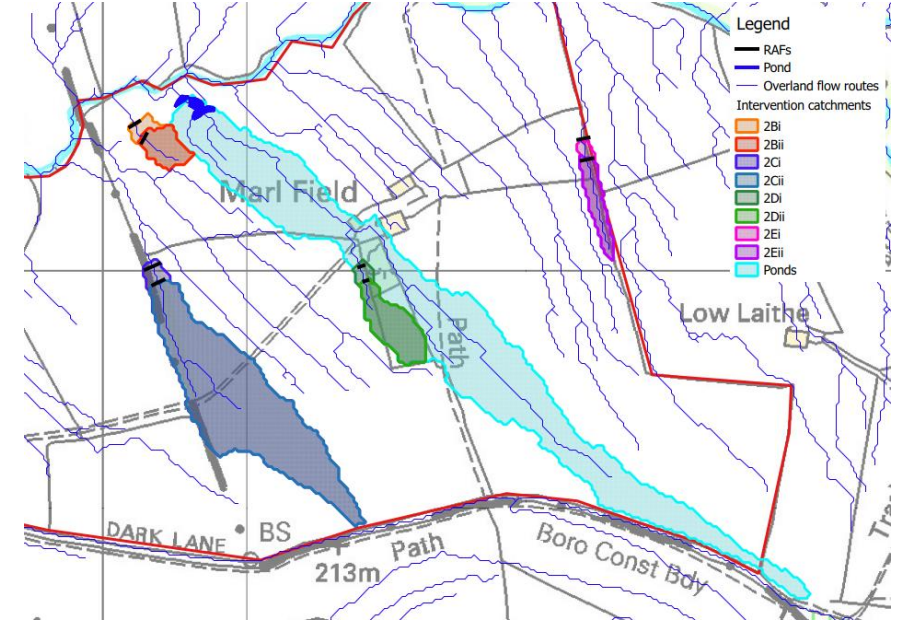


The SuDS Manual

Rev	Date	Drawn	Description
P2	06/10/2018	PMKM	Updated Concept Layout for Discussion



Figure 22.2: Plan and elevation of vegetated detention basin



Constructing a Better Environment

Safety, Health, Environment and Wellbeing (SHEW)
Code of Practice (CoP)
May 2018

Draft For Discussion
(Not for External Distribution)

Rev	Date	Drawn	Description	CHK'd	App'd	Sketch No.	Scale	Status
P2	06/10/2018	PMKM	Updated Concept Layout for Discussion			398931-MF-SK02	A3	PRE

3. Definition

DRAFT FOR DISCUSSION
(Not for External Distribution)



LEGEND

Existing Utilities/Services

- Overhead power line - Norther Power Grid 11kV Electricity Supply
- Below Ground Water - Yorkshire Water Binch [203mm] uPVC Raw Water Main
- Below Ground Telecoms - BT Apparatus

Proposed Fencing (and access point)

- New post and wire stock-proof fencing along indicated route (no barbed wire).
- Pedestrian gate (location shown as red circle) on alignment of fencing to allow access into enclosed areas (B1A, B1B, B2, H1A and H1B)
- Proposed sections of post and rail fencing to transition between post and wire fencing and existing boundaries (e.g. dry stone walls, fences, trees etc)

Proposed Trees

- Trees (T1 to T9) to be a mixture of Acer, Quercus and Fraxinus planted approximately 1m away from the existing dry stone wall boundaries
- Trees to be protected by tubular sleeves set within post and rail tree guards incorporating stock-proof mesh
- Existing dead Sycamore tree between T1 and T2 to be felled to allow light for new trees. Felled wood to be re-used on site for habitat creation

Proposed Native Hedging

- Hedging H1 and H1B to be a mix of native species, planted in 300mm spacing along alignment of existing post and wire fencing
- Wire from existing post and wire fencing to be removed (posts to be retained to assist with hedge alignment)
- Hedge H1A western edge of hedge to terminate at intersection of existing field boundaries. Eastern end of hedge to connect to existing gate
- Hedge H1B western end of hedge to connect to existing gate. Eastern end of hedge to terminate approximately 10m before existing fencing to leave gap for future gate (no gate provided as part of works)

Proposed Field Naturalised Buffer Zone

- Buffer Zone B1A: comprises a min. 2m width buffer strip of understorey planting with a mixture of water tolerant native shrubs and Emorsgate EM8 'Meadow mixture for wetlands'. Fencing to be provided to exclude livestock. Existing overhanging trees to be pruned as necessary.
- Buffer Zones B1B and B2: comprise of riparian planting. Fencing to be provided to exclude livestock

Proposed Runoff Attenuation Feature (RAF)

- RAF W1: comprises an earth bund formed in a horseshoe shape to create a seasonal wetland area. Seed mix, with Marsh Marigolds, to be sown
- RAF: S1A and S2B: timber stake 'Viaduct' type check dams
- RAF S2A to be (Materials / Construction TBC)
- RAF S2B to be woven Hazel barrier to catch channel debris upstream of RAF S2A

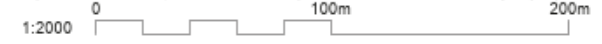
Proposed Leaky Dams

- Leaky Dams LD1 and LD2 to be formed from suitable timber
- Position of any stakes to be located to minimise damage to existing tree root zones.

Proposed Permeability Improvements

- All identified fields to be aerated using tractor mounted aerator

DRAFT: details for items 13-19 inclusive (listed below) to be confirmed



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			P01	06/11/18	AB/AA	Draft issue for discussion	CM	PM	Leeds FAS2 NFM Marfield Farm (Earby) Pilot Site Preliminary Landscape Masterplan	Checked	C Mendel	CM
									Approved	P Millard	PMKM	
									Scale at A3 1:2000			
Drawing Number ENV0001395C-MMD-XX-MF-DR-L-C0700									Security STD	Status S2	Rev P01	

Safety Moment

- **What hazards did you spot on site?**

Safety Moment

Marfield Farm - Webcam footage

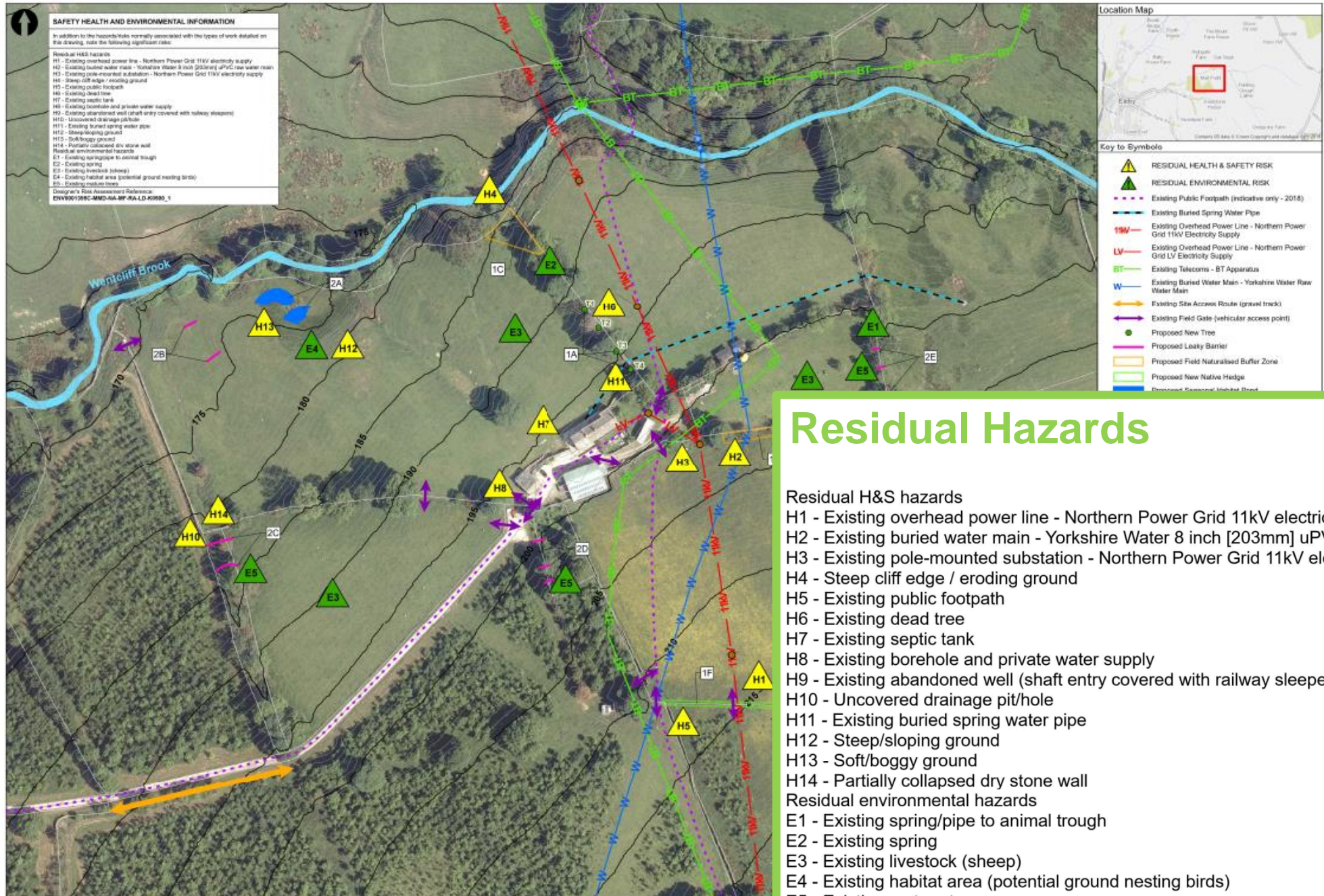


Safety Moment

Marfield Farm - Webcam footage



3. Definition



Residual Hazards

- Residual H&S hazards
- H1 - Existing overhead power line - Northern Power Grid 11kV electricity supply
 - H2 - Existing buried water main - Yorkshire Water 8 inch [203mm] uPVC raw water main
 - H3 - Existing pole-mounted substation - Northern Power Grid 11kV electricity supply
 - H4 - Steep cliff edge / eroding ground
 - H5 - Existing public footpath
 - H6 - Existing dead tree
 - H7 - Existing septic tank
 - H8 - Existing borehole and private water supply
 - H9 - Existing abandoned well (shaft entry covered with railway sleepers)
 - H10 - Uncovered drainage pit/hole
 - H11 - Existing buried spring water pipe
 - H12 - Steep/sloping ground
 - H13 - Soft/boggy ground
 - H14 - Partially collapsed dry stone wall
- Residual environmental hazards
- E1 - Existing spring/pipe to animal trough
 - E2 - Existing spring
 - E3 - Existing livestock (sheep)
 - E4 - Existing habitat area (potential ground nesting birds)
 - E5 - Existing mature trees

Lessons Learned

- **Limited opportunity for storage** – steep gradients and limited ‘floodplain’ in valley base meant all features were small and on sloping ground
- **Design life** – NFM for Leeds needs to continue to function until 2069 (50+ years) therefore design life of many timber features would be exceeded
- **Surveys:**
 - **Ecology Walkover** - Phase 1 Habitat Survey: breeding birds / seasonal constraints
 - **Utilities** – PAS128 ‘Underground Utility Detection’: above and below ground services
- **Hydraulic Modelling/Analysis** – Challenging to model individual ‘farm scale’ interventions. Key concern was ‘synchronisation of peaks’ with adjacent tributaries / watercourses / catchments