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National Trust Purbeck:
Swan Brook NFM Opportunities

Feasibility Assessments

Dr Peter Stone

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1. Introduction

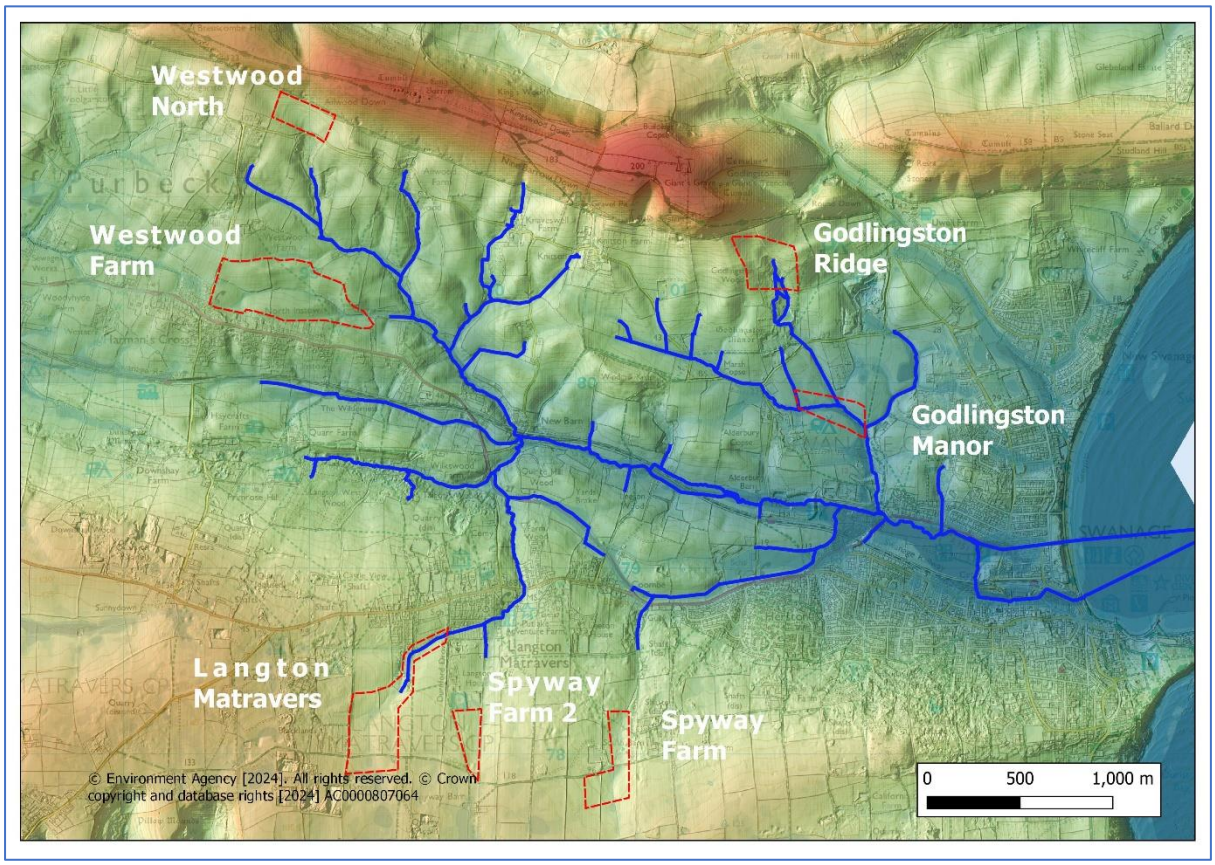
The National Trust are managing an area of approximately 3600 hectares of land at Purbeck. The land is generally farmed but is also being managed for conservation including in this case improvements to surface water hydrology. Within the holding is the Swan Brook catchment which drains to Swanage.

A Natural Flood Risk Management approach is being implemented in the Swan Brook catchment to complement existing management approaches. Funding has been secured to implement measures at 7 sites which are in the holding of the National Trust.

An investigation is reported below to document surface flow pathways on the selected sites and to identify if there is are potential measures to work with natural processes to reduce flood risk through catchment interventions. The investigation to identify potential measures has:

- Undertaken desk-based site characterisation from mapping and interrogated the Environment Agency LiDAR (DTM) data for an understanding of localised topography;
- Completed a site visit to develop site specific detail, identifying site-specific processes and defining measures to work with natural processes to reduce flood risk;
- Developed an inventory of potential measures.

Seven locations are considered in the following report.



N.B. Detailed locations are provided within the report using the What3words referencing system

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7. Spyway Farm

Surface Water Drainage and Topography

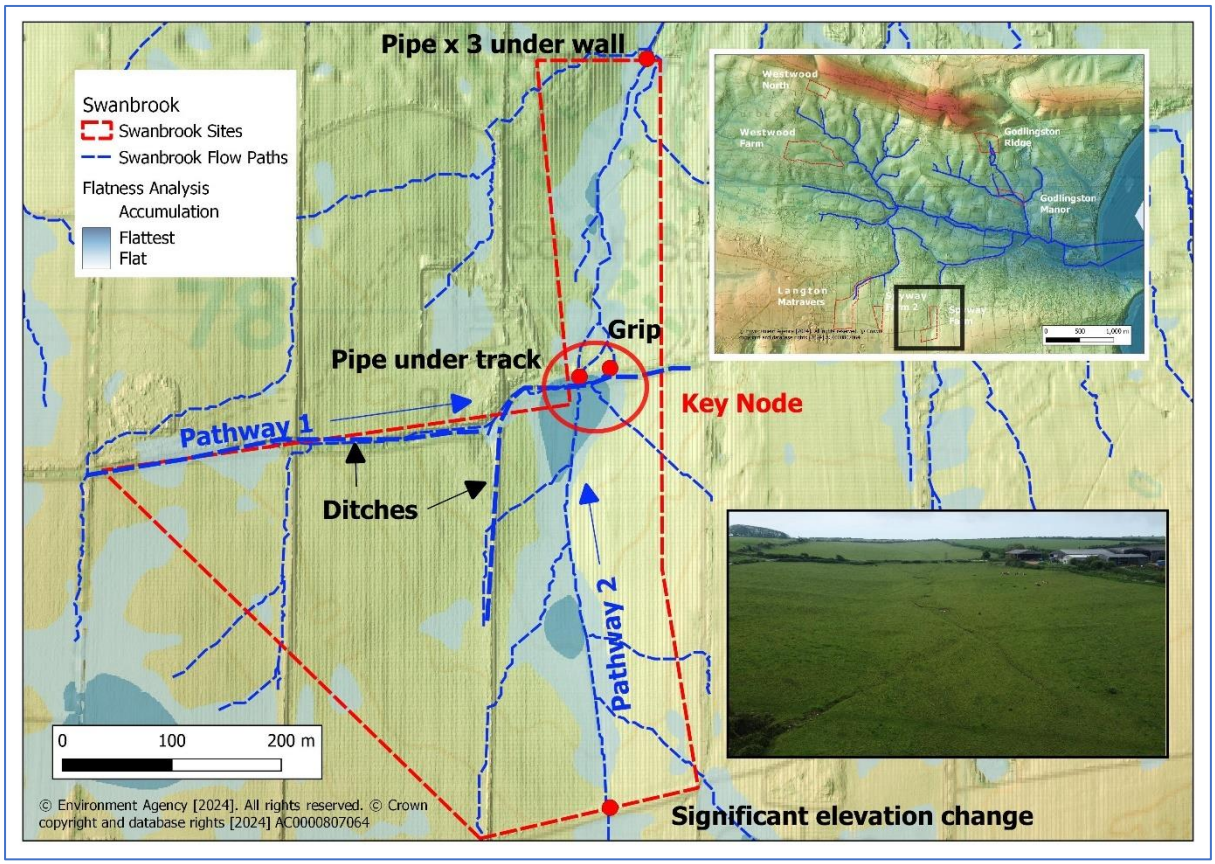
An ephemeral runoff pathway develops within a cluster of field sources. A series of gently sloping fields concentrate runoff through a combination of field ditch drainage and runoff pathways developing in naturally occurring low points in topography.

Two source pathways develop. One (Pathway 1 below) originates from the west and is concentrated through deep drainage ditches around the perimeter of two fields. Evidence of exposed ditch bed sediment and deposition of material suggests that the pathway can be fast flowing with an erosive power.

A second pathway (Pathway 2 below) develops from the south and is more likely a combination of emerging groundwater/high water table and rainfall runoff during rainfall-runoff response. A significant vertical change in elevation of over 1m occurs between the field south of the holding and the start of pathway 2. There was no evidence of an erosive surface runoff pathway between the two fields.

Both paths join at a key node to develop a single pathway through the last downstream field of the site area. It is expected that a significant flow develops which lasts for a short duration period (hours) quickly delivering runoff downstream.

A number of ponded holes have been created within Pathway 2 and the joined runoff downstream pathway.



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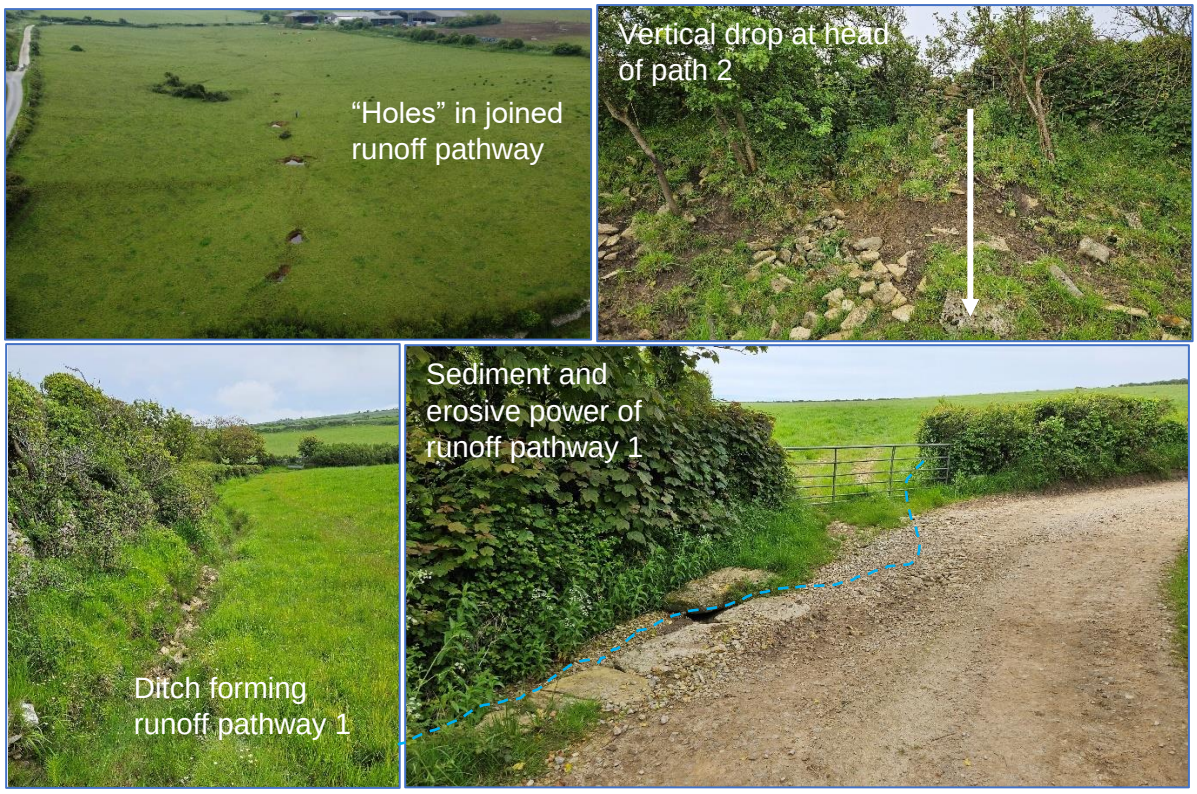
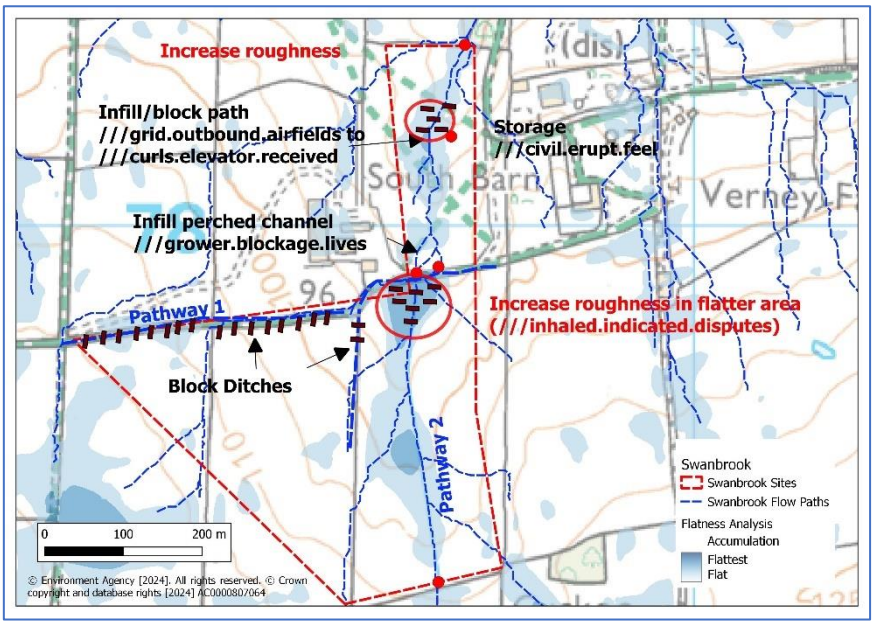


Approach to working with natural processes.

The current runoff pathway is concentrating flow from rainfall-runoff generating storms either into a drainage ditch or creating a channel to the point that it is eroding an ephemeral pathway within the landscape. Methods to slow the delivery of runoff downstream within the ditch channel forms are proposed initially. Where space allows, rather than a concentrated flow, a shallow diffuse flow will create more in-catchment storage and slow velocity.

In combination with slowing flow delivery, there are opportunities to create storage within the catchment fields which generate runoff.



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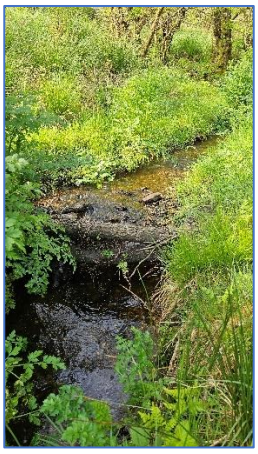
Natural Flood Management Opportunity – In-ditch slow flow (Pathway 1)

The incised form of the drainage ditch is an efficient downstream delivery of storm related runoff and flow. Addition of woody debris to the channel as a series of baffles is proposed specifically with the intention slow the delivery of flow but also to trap sediment. Using woody debris as a series of steps will also break the fetch or distance of the runoff reducing power.

Two field perimeter ditch reaches are proposed, with addition of up to 6 dams spaced at 20m per field.

Examples of the style of basic design of woody debris in the channel is shown below.



The leaky woody debris dams will be installed manually. Works will be undertaken using a chainsaw and logs manually manoeuvred into place. Any fixings will be manually installed.

The approach to installation will be:

- Source tree trunks to bring to site – there did not appear available locally won material;
- Secure the trunk (s) with stakes made from local durable wood, flat to the bed of the channel, to create a leaky structure which can be overtopped. The height of the dam should be no more than 25% of the ditch height;
- Stakes securing the tree should be on the downstream side, angled so the top of the stake is pointing upstream and >0.1m above the top of the felled tree.

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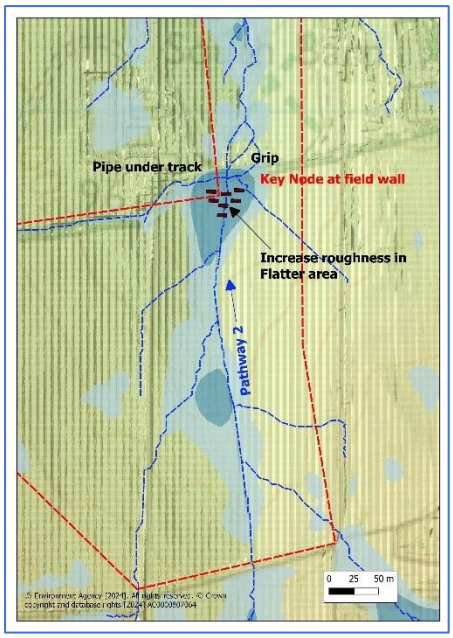
Natural Flood Management Opportunity – "Floodplain" reconnection (Pathway 2)



The flatness analysis indicates that there is an area within Pathway 2 where it joins to the key node which has potential to create more storage within the catchment. The area within the field upstream of the track which crosses the pathway is currently seasonally wet. Upstream, flow Pathway 2 is previously concentrated into a channel but becomes a diffuse flow at the flatter area. At the field boundary at the foot of the flatter area, flow is re-concentrated into a hole through the field boundary wall for delivery under the tack and downstream.

The current reach of diffuse flow is helping to raise the water table and store water within the catchment area. It is possible that a more defined pathway develops during response to rainfall generated runoff so a further measure to slow flow can include increasing the roughness of the flatter area by addition of logs within the pathway before concentration into the hole through the field wall.


Flatter area with diffuse flow in runoff pathway 2


Hole in wall concentrating flow

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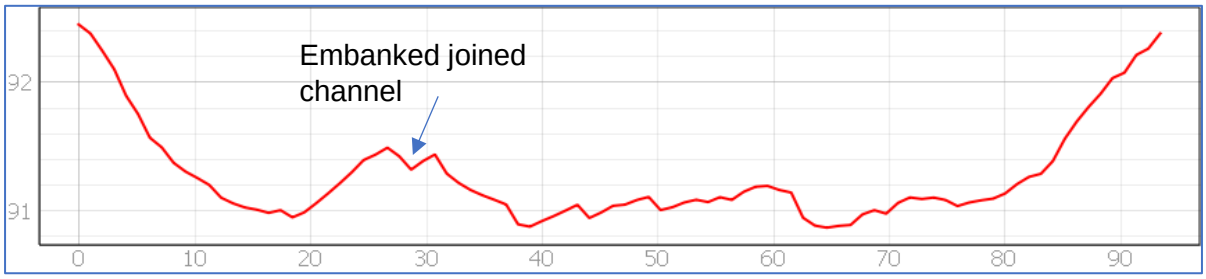
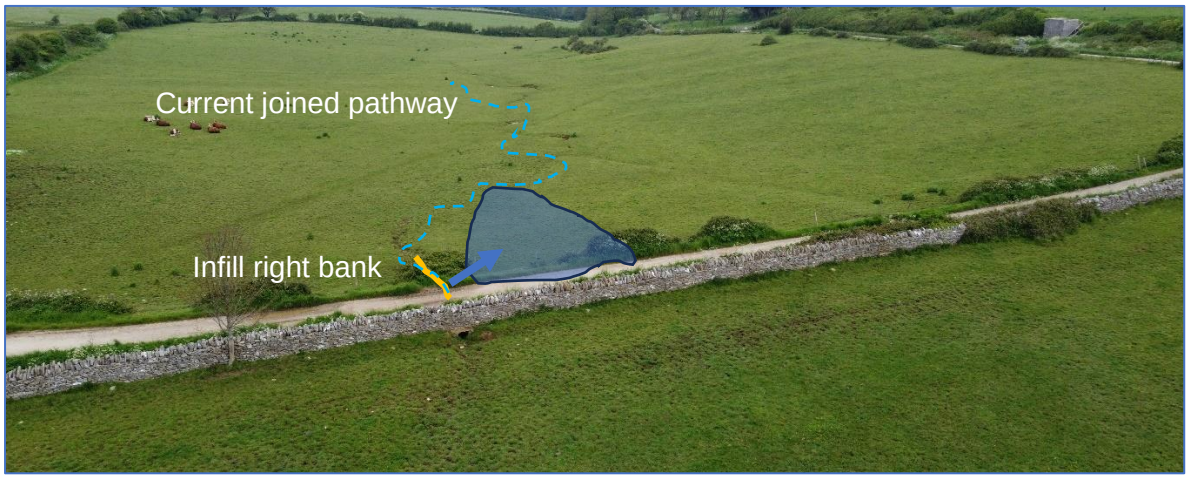
Natural Flood Management Opportunity – "Floodplain" reconnection (joined pathway)

Runoff pathways 1 and 2 combine on the upstream side of the crossing track (Priest's Way) and pass under the track in a piped culvert. On the downstream side of the track the joined flow path is held within an embanked channel which is outside of the natural low-lying land.



It appears that the current track crossing culvert is not at the lowest point in the natural valley form. Rather than move the culvert, it is proposed to restore the downstream joined flow back into the lower lying land by infill of the embanked channel through pushing the right bank (looking downstream) material into the channel. The combined flow from the culvert should be allowed to spill into the downslope field as a diffuse flow without concentration into any channel.



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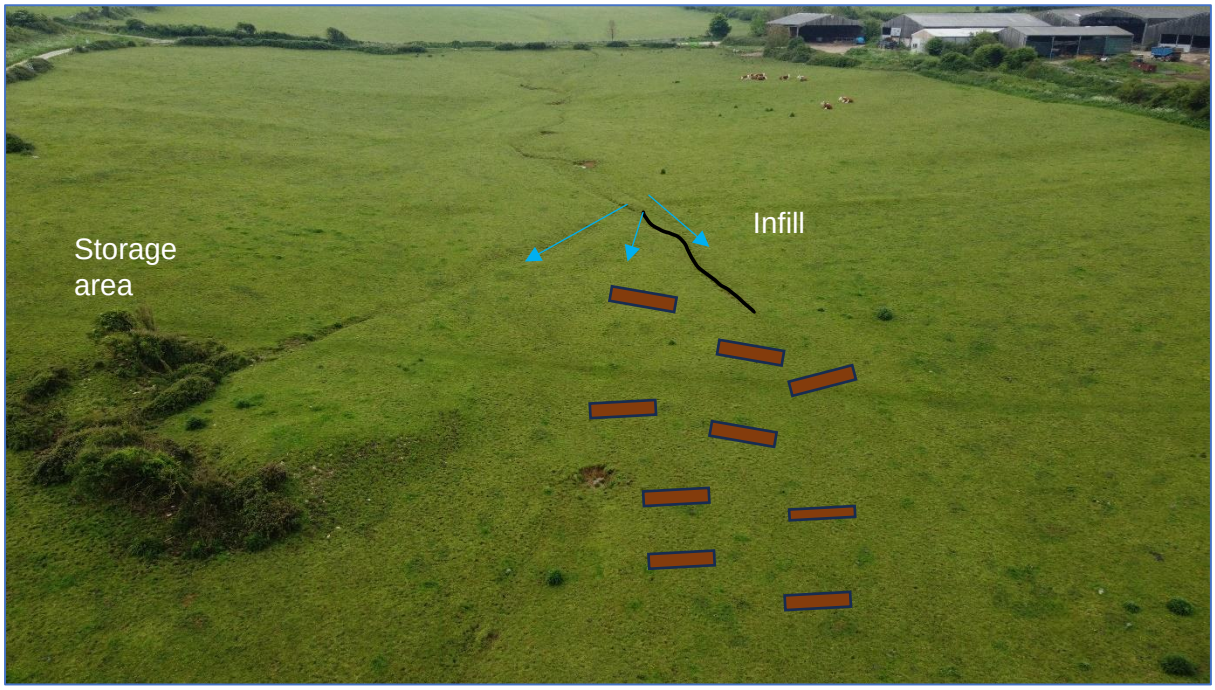
Natural Flood Management Opportunity – "Floodplain" reconnection (joined pathway no. 2)

Within the joined runoff pathway, it appears a number of "holes" have been created to store water and slow flow. The flatness analysis suggests a limited area of flatter land which could be connected as a floodplain to raise local water table so it is proposed that the storage features remain.

There is however one area of slightly flatter ground where the joint pathway runoff channel becomes less well defined and could be enhanced to increase potential storage during rainfall runoff events. In a similar way to measures for pathway 1, increasing roughness by addition of trunks/logs into the pathway will help slow flow and create storage.

There is also a (ponded) depression within the field which could be used to store flow but appears less well connected to the current runoff pathway. An infill of a reach of the current runoff channel will help connect the depression more frequently and increase the diffuse spill of flow into the flatter area.



Consideration may be required of a realignment of the public footpath which crosses the field

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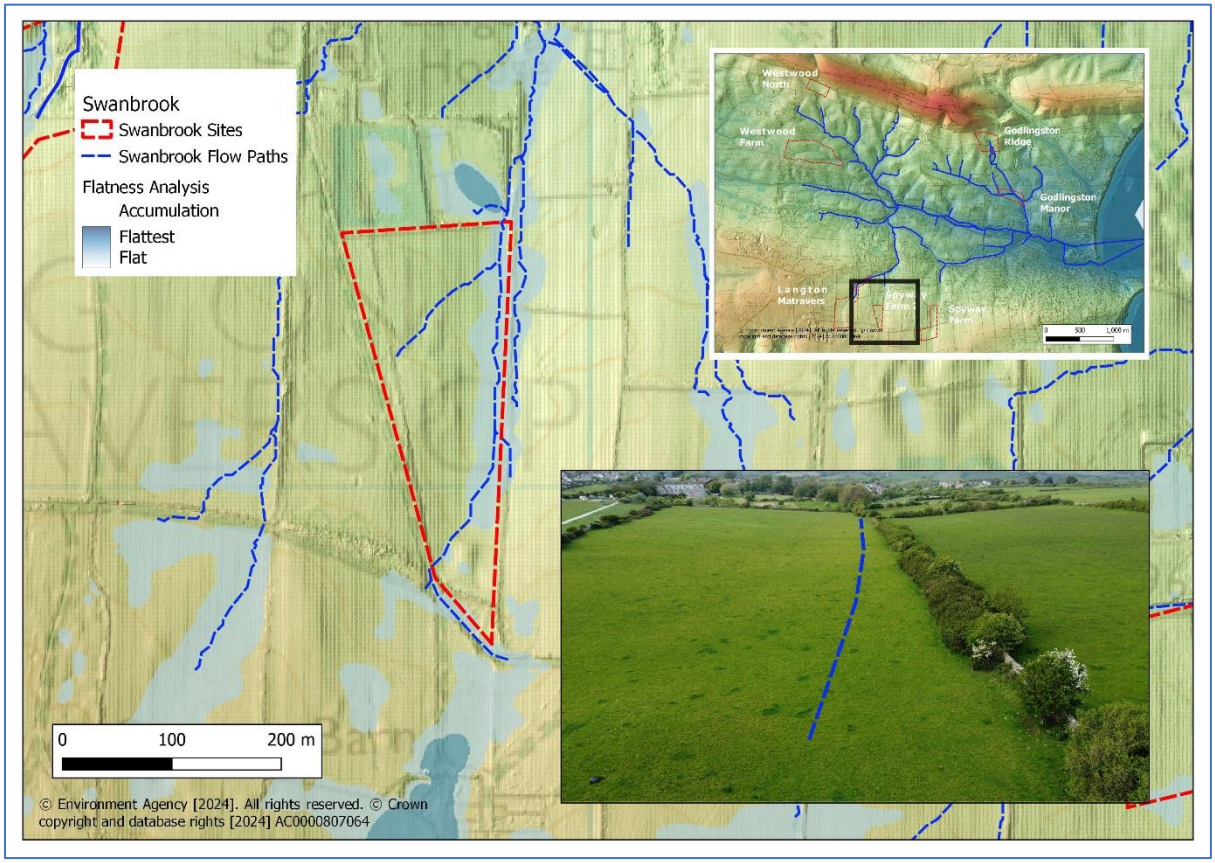
8. Spyway Farm 2

Surface Water Drainage and Topography

An ephemeral runoff pathway develops within a single field. A natural concentration of runoff in a topographical depression helps an efficient delivery of runoff generated during rainfall-runoff storm events.



Approach to working with natural processes.

The current runoff pathway is concentrating flow from rainfall-runoff generating storms. Methods to slow the delivery of runoff downstream are proposed initially. Opportunities to create storage within the catchment field which generates runoff are proposed.

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Natural Flood Management Opportunity – Runoff Storage

The flatness analysis suggests that there is a natural depression which can be utilised to create temporary storage in scrape features within the field. The scrape features can be created using a digger to remove a shallow depth of top soil ca. 20-30cm to enhance the depression feature. Removed material can be used to define the feature with a shallow downstream bund.

Four features are suggested which are in the order of 20m in diameter each. An example of a similar application is shown as well.