

Drainage Strategy for the Proposed Wetland at Stockham Marsh

Produced for **Environment Bank** by **South West Natural Solutions**

1. Introduction

Stockham Marsh Wetland is situated at Stockham Marsh Farm, approximately 600 m northwest of the hamlet of Spirthill in Wiltshire. The project area gently slopes from east to west. Environment Bank aims to transform existing agricultural fields and isolated woodlands into a diverse mosaic of wildflower grasslands, native mixed scrub, woodlands, ponds, and wetland habitats. The design comprises 12 ponds, varying in size from 54.00 m² to 6,771.50 m², distributed across four land parcels.

The Cade Burna, a headwater tributary of the River Avon and designated by the Environment Agency as a statutory main river, flows westerly through the project area. This watercourse is fed by springs that drain from the surrounding hills. There are few properties in close proximity to the site, with the nearest located at Stockham Marsh Farm, approximately 390 m northwest of the center of the project area.

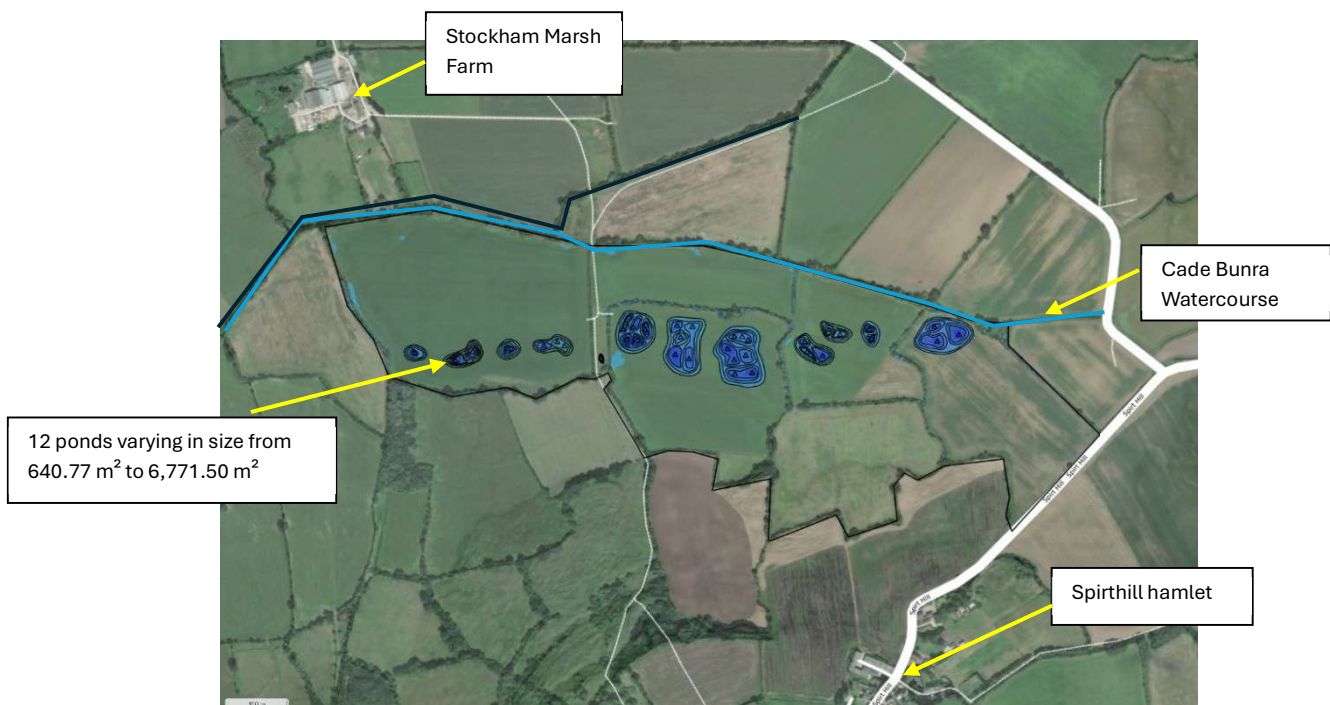


Figure 1: A map from Scalgo Live showing the 12 proposed ponds for the Stockham Marsh wetland creation project.



This report has been created to accompany the planning application for the proposed wetland at Stockham Marsh to demonstrate that the design meets the following key requirements:

- A 40% uplift in peak rainfall intensity, taking account of climate change in line with Environment Agency guidance.
- Achieves a minimum 20% betterment against calculated greenfield runoff rates for all storm events between the 1-in-1 year and the 1-in-100 year return period storm events.
- Safely manages exceedance flows for events greater than the 1-in-100-year plus climate change (40%)
- Ensures all surface water flows are wholly and safely managed within the site boundary.
- Minimises flood risk to people, property, and neighbouring land.

A single principal modelling tool has been used to inform the conclusions outlined within this report. These conclusions are based solely on modelling outputs, and no site visit has been undertaken to verify site conditions.

- **SCALGO Live** utilises LiDAR, terrain, and rainfall data to model surface water flow paths and accumulation across the landscape. The software provides a safe and dynamic environment in which to test and refine proposed wetland interventions.

Rainfall data has been sourced from the UK Centre for Ecology and Hydrology's Flood Estimation Handbook (FEH). Please refer to Appendix 1 for data outputs.





2. 1-in-1 Year

1-in-1-year weather events refer to routine rainfall events with a 100% annual probability of occurrence. Rainfall depths of such events were modelled in SCALGO Live using site-specific rainfall data derived from the FEH (refer to Appendix 1).

A range of storm duration scenarios were assessed, including rainfall depths over 1-, 3-, 6-, 12-, and 24-hour periods. To evaluate the performance of the proposed wetland, modelling was undertaken for both the existing site conditions and the post-development wetland creation. Full details of the modelling results are provided in Appendix 2.

Using the 24-hour duration event (refer to Figures 3 and 4) as an example, it is evident that during periods of maximum rainfall, all surface flows are contained within the site before discharging into the Cade Burn. Surface water accumulation is limited due to the site topography, which slopes towards the Cade Burna and supports continuous drainage. Flood risk to nearby properties and road infrastructure is considered to be low, as these features are located upslope of the project area and outside the main surface water flow routes. Simulations indicate that flow paths stay within project boundaries, ensuring flood risk to neighbouring land is not increased.

This general pattern is maintained under the proposed wetland scenario. While surface water temporarily pools within the wetland features, the shallow storage depths and overall sloping topography allow flows to continue along their established routes, ultimately discharging into the Cade Burna. The level of flood risk to nearby properties and road infrastructure remains low under the wetland creation scenario due to their upslope location. The modelling also shows that surface flows to neighbouring land are not increased by the introduction of the ponds, as surface flows remain within the project boundaries.

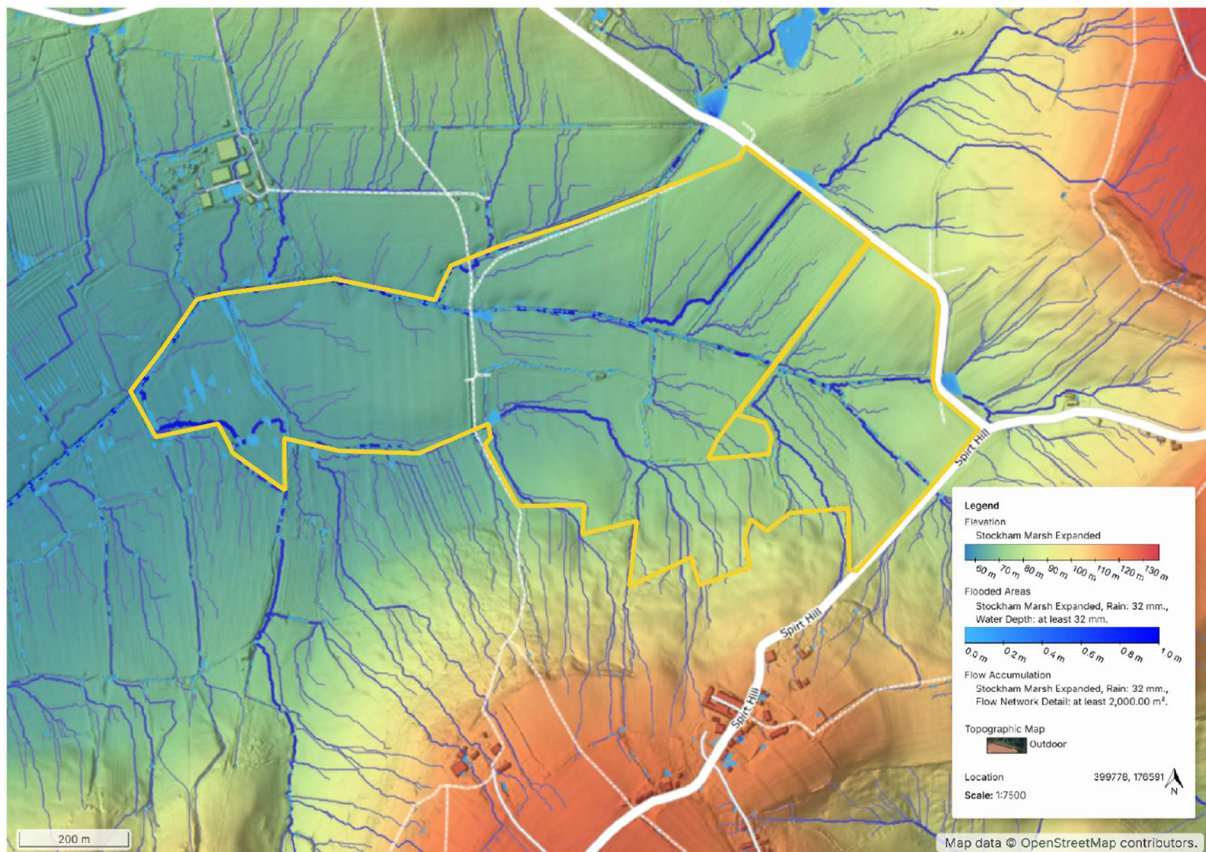


Figure 3: Model of the current site under 1-in-1 year rainfall conditions over a 24-hour period (total precipitation of 32mm). Model created using SCALGO Live with the project boundary outlined in yellow.

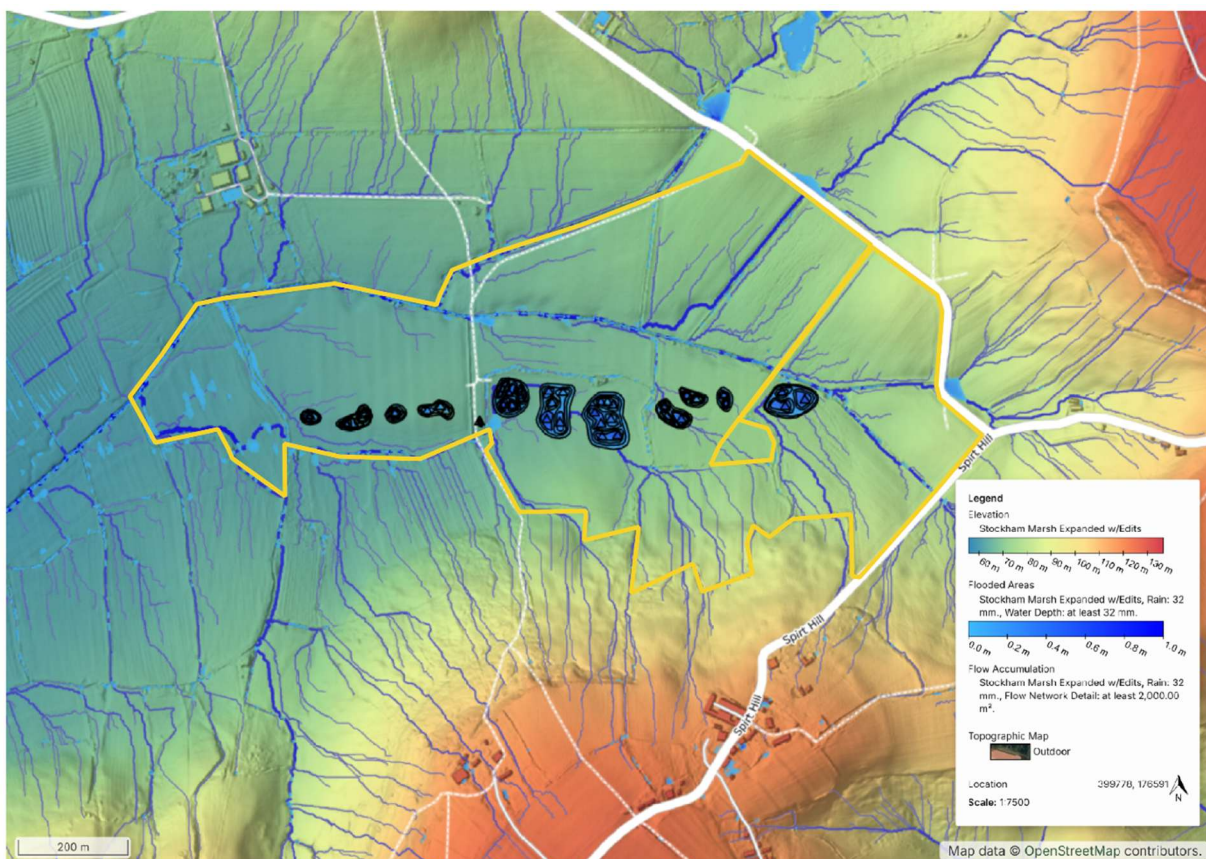


Figure 2: Model of the proposed wetland under 1-in-1 year rainfall conditions over a 24-hour period (total precipitation of 32mm). Model created using SCALGO Live with the project boundary outlined in yellow.

3. 1-in-100 Year

A 1-in-100 year event refers to a weather event, such as a storm, flood, or period of heavy rainfall, that has a 1% chance of occurring in any given year. Rainfall depths for these events were modelled in SCALGO Live using site-specific rainfall data derived from the FEH (refer to Appendix 1). As with the 1-in-1 year assessment, total rainfall depths over periods of 1, 3, 6, 12, and 24 hours were modelled for both current site conditions and the proposed wetland scenario. The modelling results are provided in Appendix 2.

Using the 24-hour duration as an example, when rainfall depths reach their peak, modelling indicates that surface flow patterns remain similar under both existing conditions and the proposed wetland scenario (see Figures 4 and 5). Surface flows are contained within the project boundaries, exiting the project area by discharging directly into the Cade Burna.

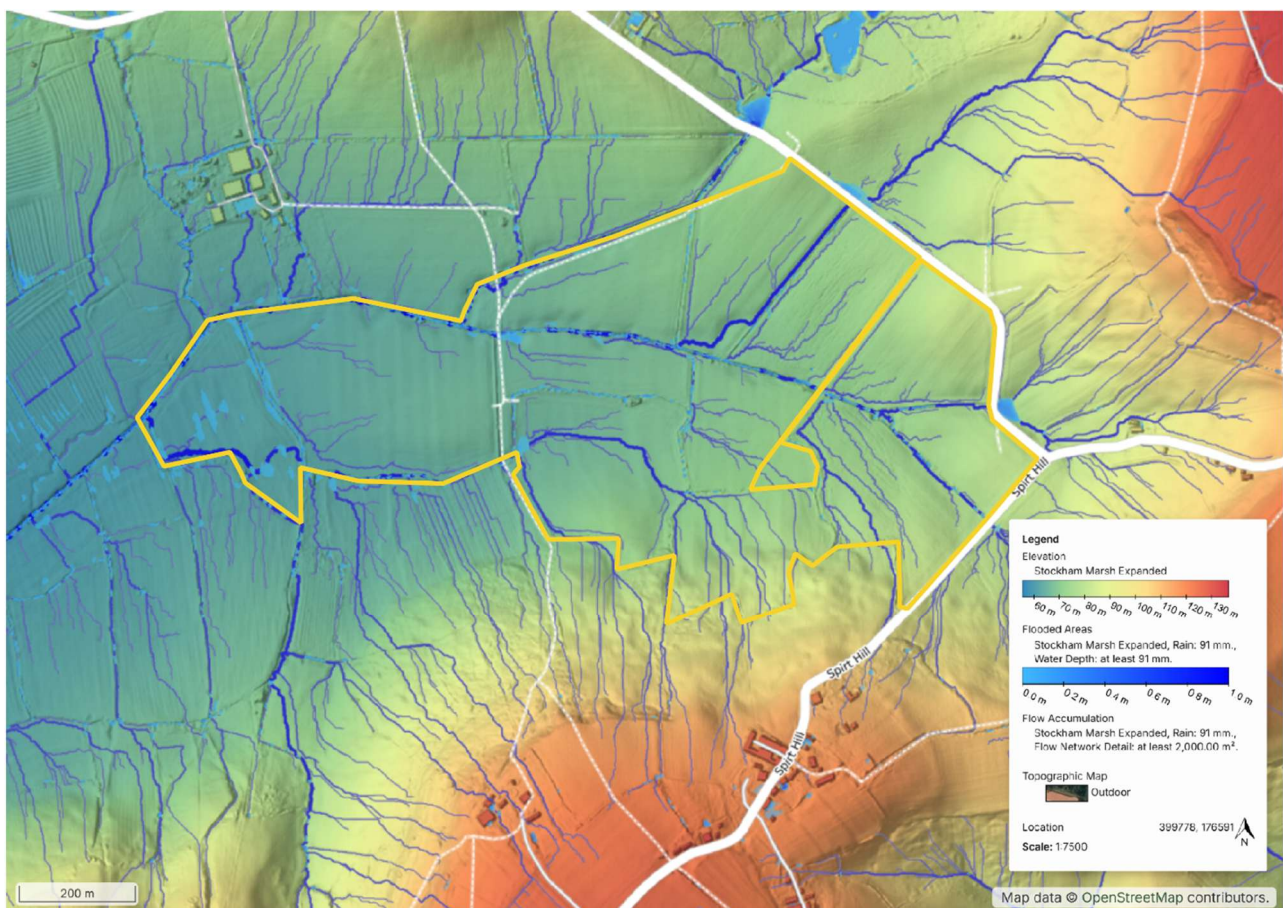


Figure 4: Model of the current site under 1-in-100 year rainfall conditions over a 24-hour period (total precipitation of 91mm). Model created using SCALGO Live with the project boundary outlined in yellow.

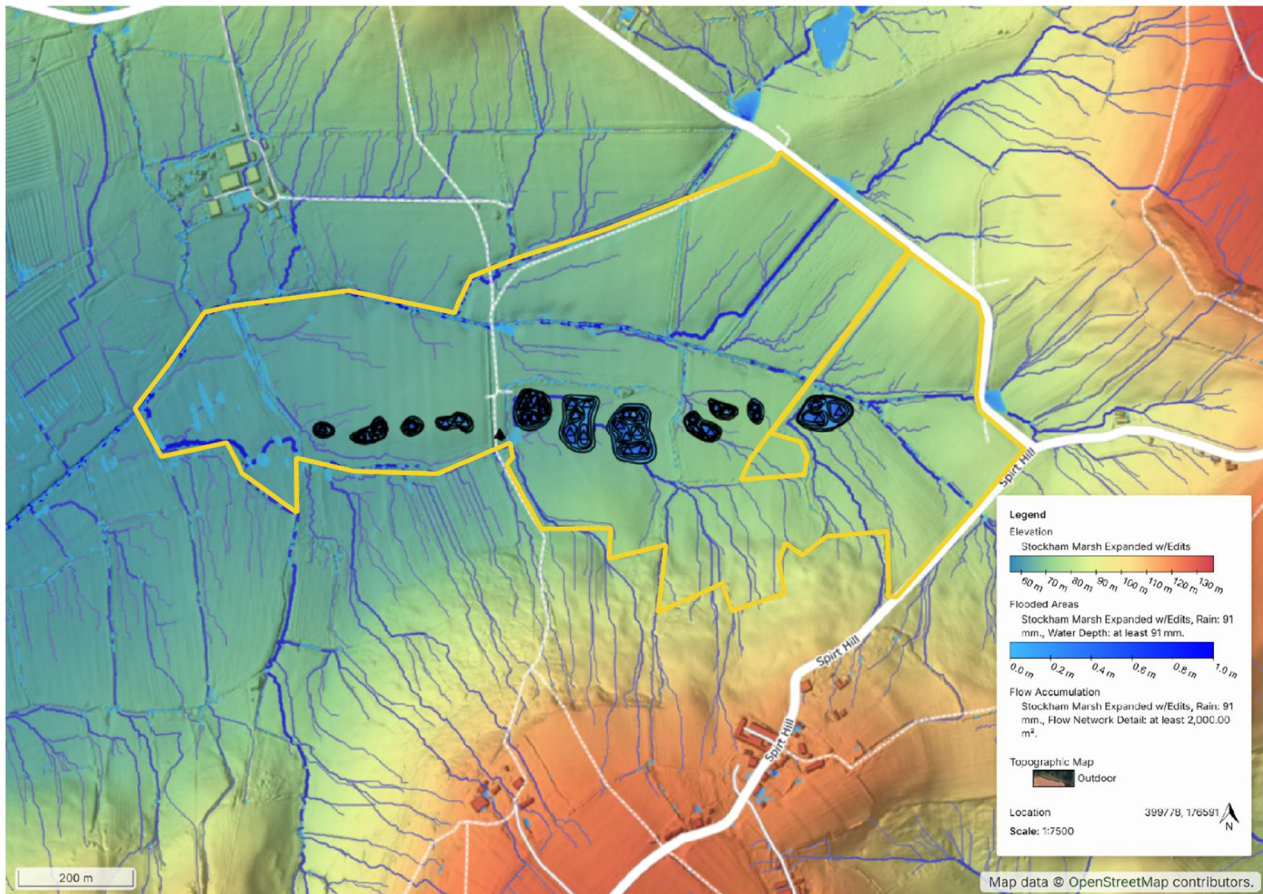


Figure 5: Model of the proposed wetland under 1-in-100 year rainfall conditions over a 24-hour period (total precipitation of 91mm). Model created using SCALGO Live with the project boundary outlined in yellow.

Surface water accumulation within the ponds shows little increase despite higher rainfall depths. For example, the volume stored within one of the central ponds under 1-in-100 year rainfall depths during both a 1-hour (38 mm) and a 24-hour period (91 mm) remains similar: 2,266.94 m³ and 2,2269.73 m³, respectively (see Figures 7 and 8). This is due to the ponds having limited storage capacity as a result of their placement on sloping ground, which prevents water from spreading widely into surrounding areas once capacity is reached. Instead, water spills from the features and is conveyed downslope along established surface flow paths. As a result, the ponds do not accumulate surface water outside of their features, nor do they redirect flows in a manner that would increase flood risk to properties or infrastructure beyond the project area.

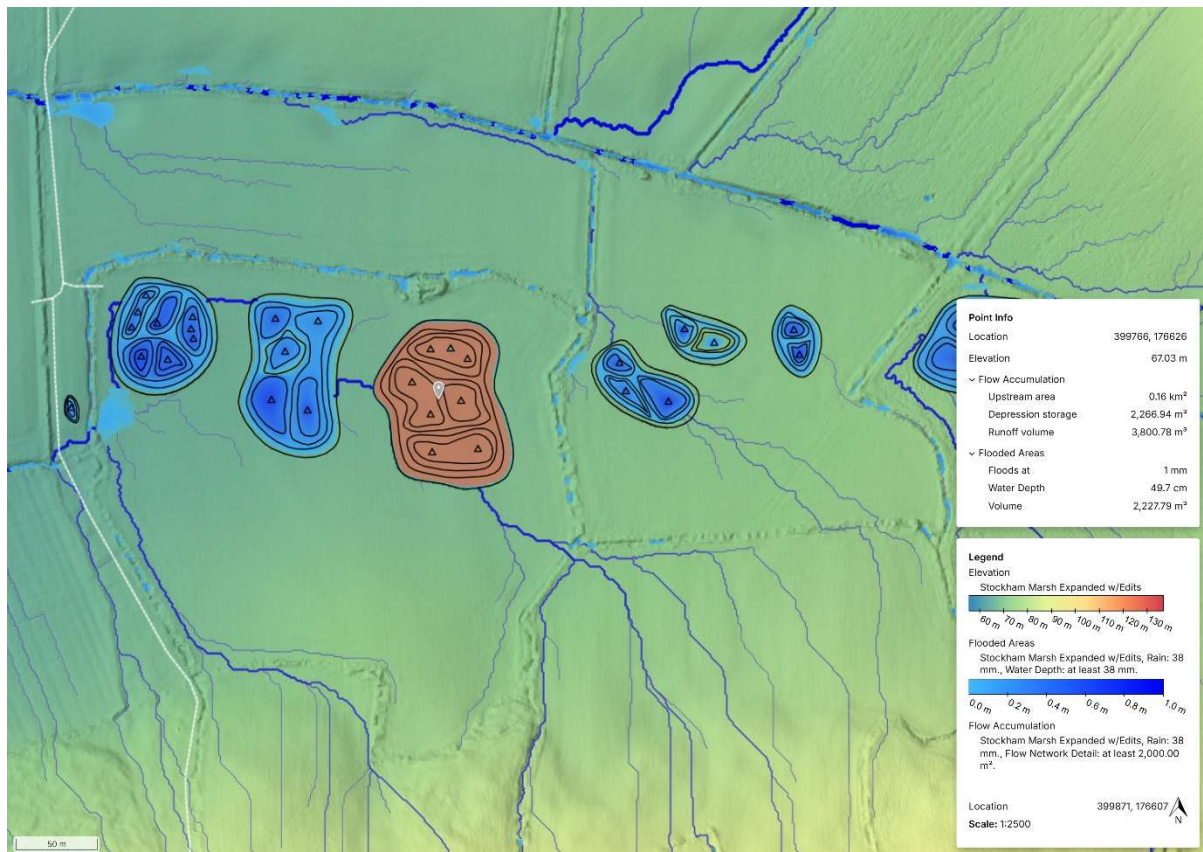


Figure 6: Model from Scalgo depicting the water volume in one of the central ponds (highlighted in brown) under 1-in-100 year event conditions, following 1-hour rainfall duration (total precipitation of 38mm). The model estimates that the pond stores approximately 2,266.94 m³ of water.

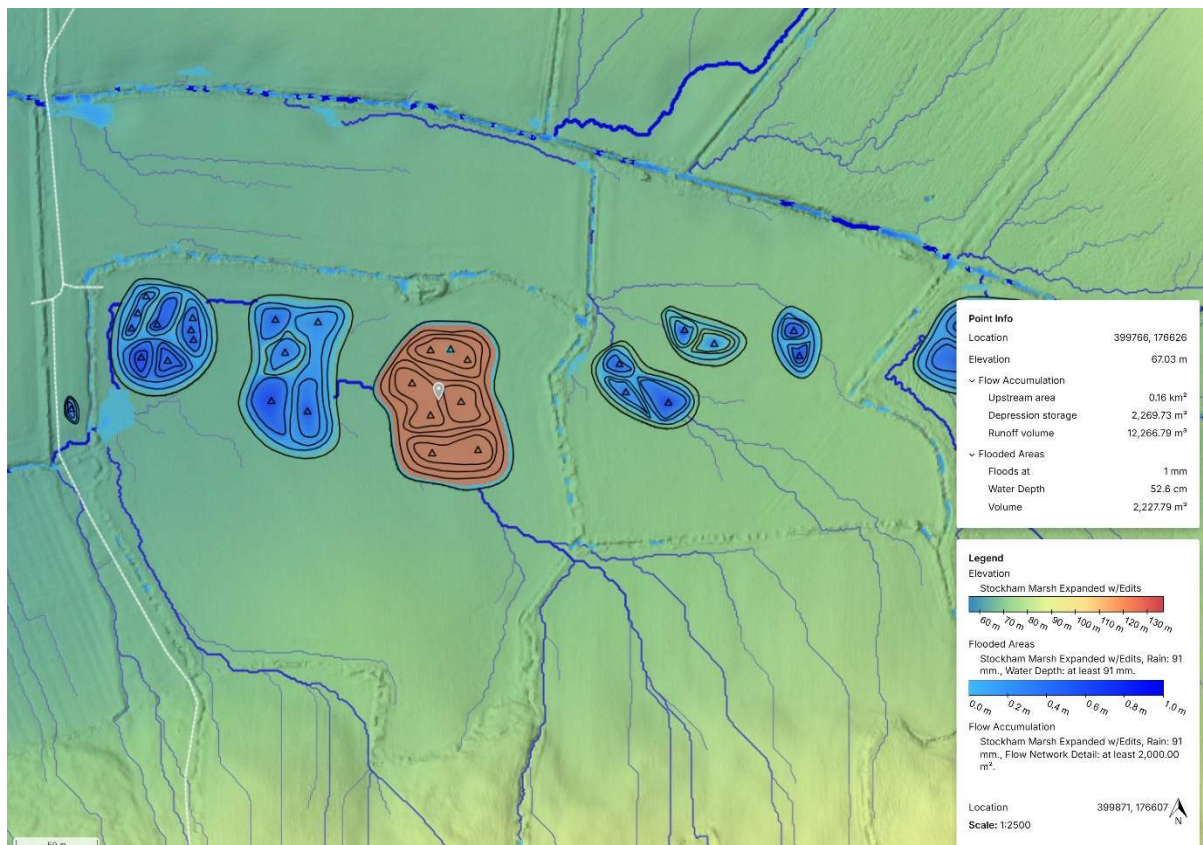


Figure 7: Model from Scalgo depicting the water volume in one of the central ponds (highlighted in brown) under 1-in-100 year event conditions, following 24-hour rainfall duration (total precipitation of 91mm). The model estimates that the pond stores approximately 2,269.73 m³ of water

4. 1-in-100 plus Climate Change

As defined above, a 1-in-100 year event has a 1% chance of occurring in any given year. To account for climate change, rainfall values were increased by 40%. Rainfall depths for these events were modelled in SCALGO Live using site-specific rainfall data derived from the FEH (refer to Appendix 1). Total rainfall depths over periods of 1, 3, 6, 12, and 24 hours were modelled for both current site conditions and the proposed wetland scenario. Full details of the modelling results are provided in Appendix 2.

Figures 8 and 9 demonstrate rainfall depths of 127 mm over a 24-hour duration, representing the highest rainfall volume modelled for the site. The modelling shows that under current conditions, all surface flows remain managed within the boundaries of the project area. Similar to the 1-in-1 year and 1-in-100 year scenarios, the proposed wetland also manages surface flows within the project boundary before discharging into the Cade Burna.

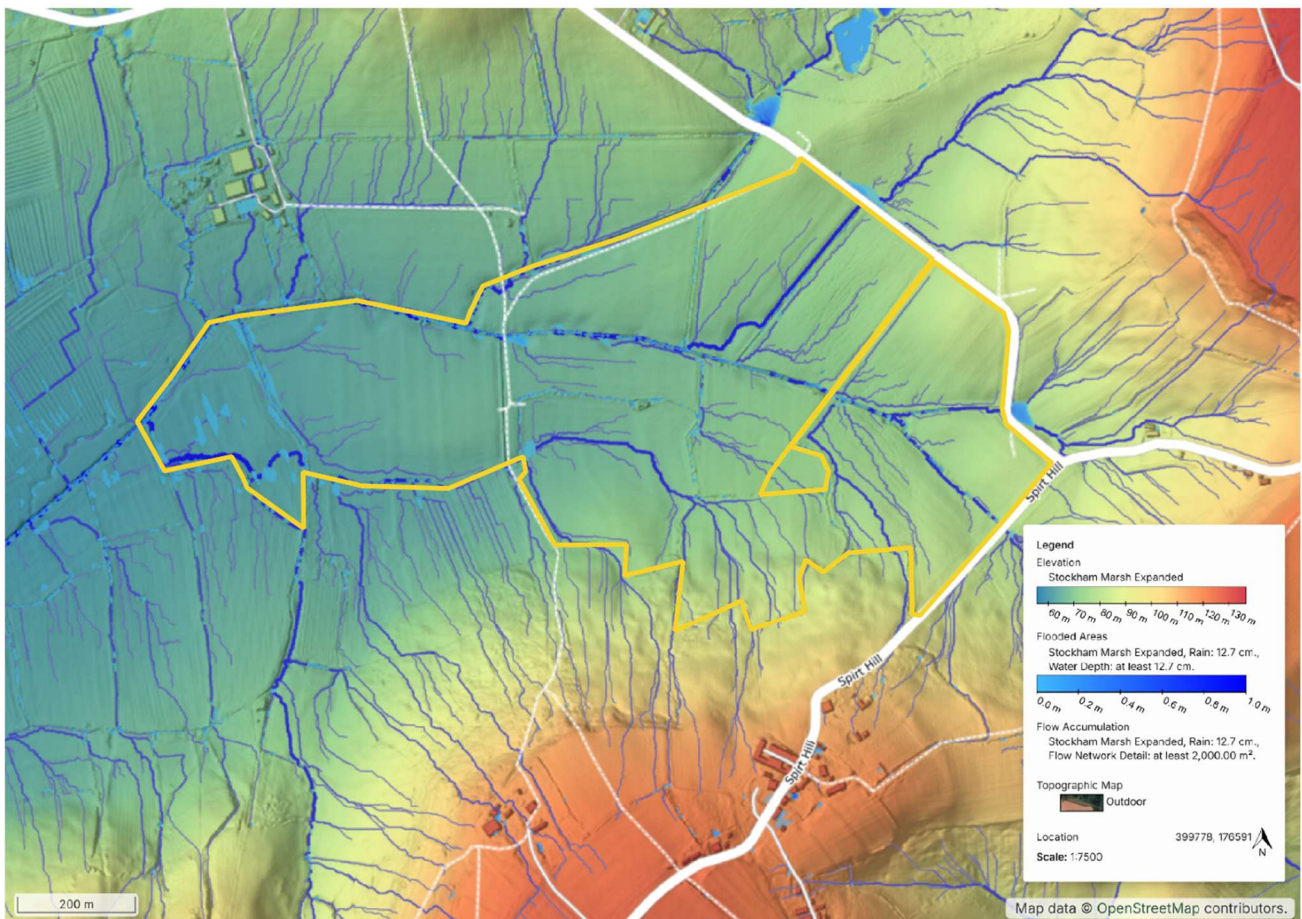


Figure 6: Model of the current site conditions under 1-in-100 year +40% rainfall conditions over a 24-hour period (total precipitation of 127mm). Model created using SCALGO Live with the project boundary outlined in yellow.

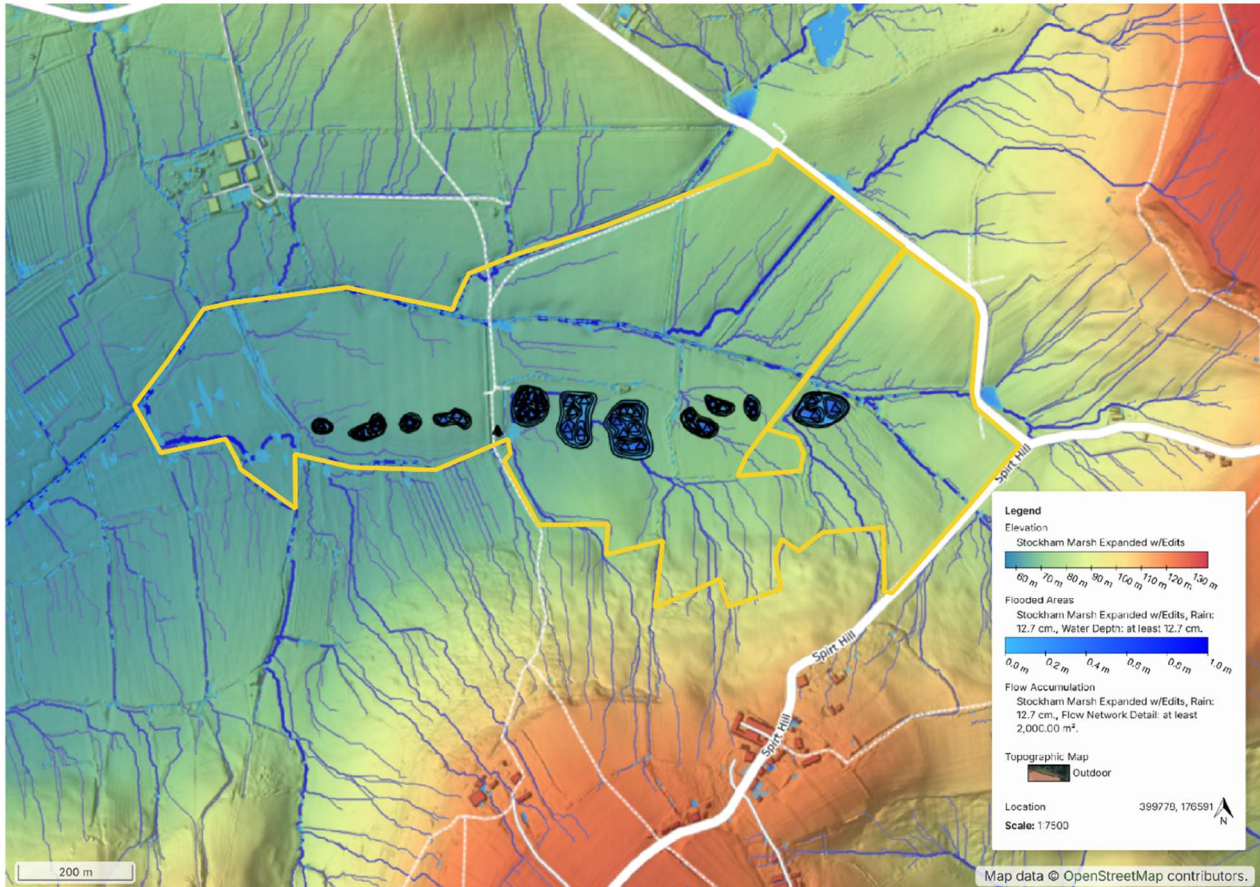


Figure 7: Model of the proposed wetland under 1-in-100 year +40% rainfall conditions over a 24-hour period (total precipitation of 127mm). Model created using SCALGO Live with the project boundary outlined in yellow.

As with the 1-in-100 year modelling, the ponds reach their maximum capacity during a 1-hour rainfall duration (volume 2,269.73 m³) (see Figures 10 and 11). Once capacity is reached, the ponds spill into established surface flow paths, with water continuing to move through the project area before discharging into the Cade Burna. As there are no raised embankments or barriers surrounding the features that could fail during an extreme weather event, the risk of sudden release of stored water is limited. As a result, flood risk to neighbouring land, properties, and road infrastructure remains low.

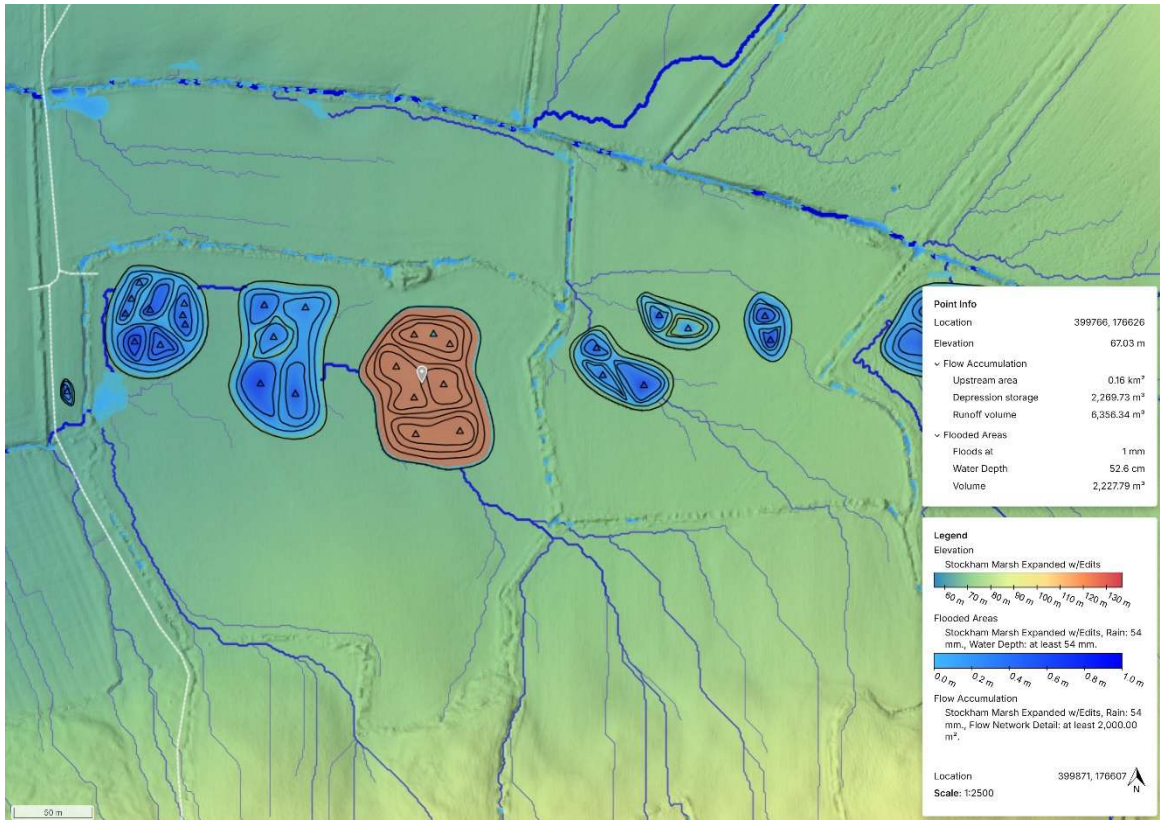


Figure 10: Model from Scalgo depicting the water volume in one of the central ponds (highlighted in brown) under 1-in-100 year +40% event conditions, following 1-hour rainfall duration (total precipitation of 54mm). The model estimates that the pond stores approximately 2,266.94 m³ of water.

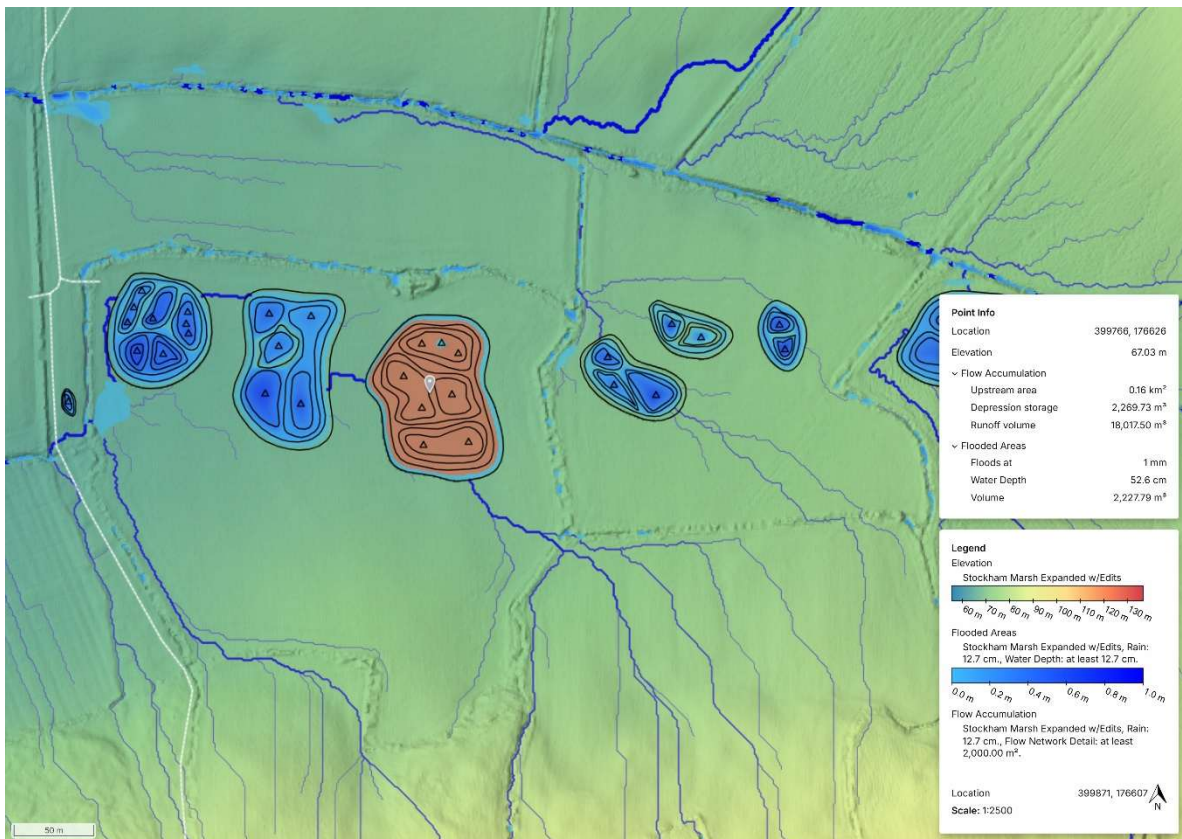


Figure 8: Model from Scalgo depicting the water volume in one of the central ponds (highlighted in brown) under 1-in-100 year +40% event conditions, following a 24-hour rainfall duration (total precipitation of 54mm). The model estimates that the pond stores approximately 2,266.94 m³ of water.

5. 1-in-100 Years +50%

To demonstrate that the wetland can manage surface flows during rainfall events that exceed 1-in-100 year +40% climate change conditions, an additional scenario using 1-in-100 year +50% rainfall depths was modelled. Although modelling of 1-in-200 year or 1-in-500 year events was considered, the associated rainfall depths for these return periods are lower than those applied in the 1-in-100 year +40% climate change scenario (refer to Appendix 1). As a result, the 1-in-100 year +50% scenario was selected as a more conservative test of the wetland's performance.

Figure 12 shows that, despite the increased rainfall depths, surface flows remain fully managed within the project area under this enhanced rainfall scenario. The modelling results presented illustrate rainfall depths for a 24-hour duration, representing the longest duration assessed and consistent with the maximum duration modelled in the other scenarios discussed within this report.

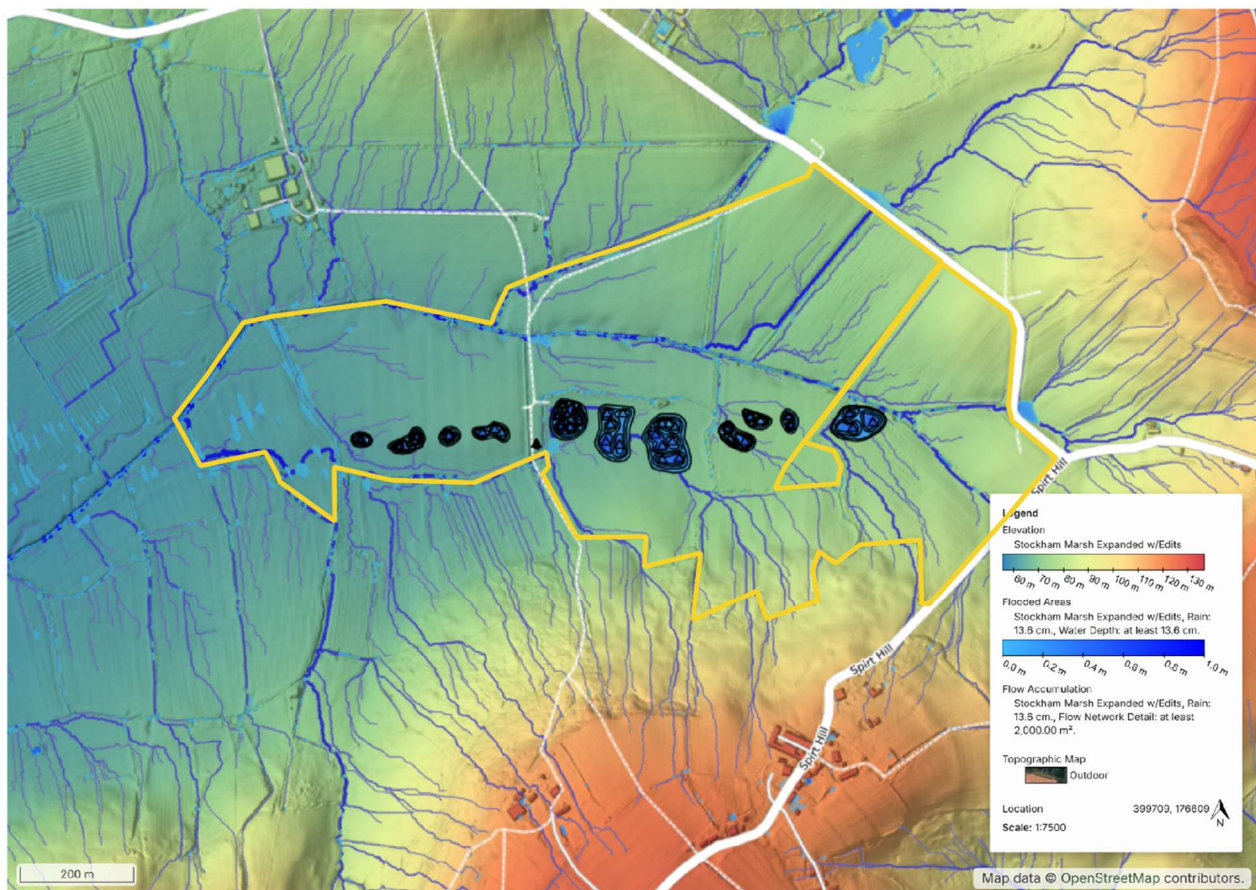


Figure 9: Model of the proposed wetland under 1-in-100 year +50% rainfall conditions over a 24-hour period (total precipitation of 136mm). Model created using SCALGO Live with the project boundary outlined in yellow.



6. 20% Betterment on Greenfield Run Off Rates

Watershed modelling was undertaken to calculate runoff volumes across the site, with the project boundary defining the limits of the contributing catchment. Baseline runoff conditions were first simulated to represent pre-development (greenfield) runoff rates. The same catchment parameters were then applied to a post-development scenario incorporating the proposed wetland features, allowing direct comparison of runoff behaviour between existing and proposed conditions.

The proposed wetland system comprises a series of ponds that begin to fill at rainfall depths ranging from approximately 1 mm to 9 mm, with initial spill between features occurring at approximately 21 mm of rainfall. FEH rainfall data (Appendix 1) indicates that short-duration rainfall events exceed these activation thresholds, with 1-hour rainfall depths ranging from 9.27 mm (1-in-1 year) to 53.6 mm (1-in-100 year plus 40% climate change). This demonstrates that the wetland storage system responds rapidly to rainfall inputs, with storage features activating and routing flows during short-duration storm events. Given this, a 1-hour rainfall duration was identified as representing an appropriate critical runoff condition for the site. Modelling results for this duration demonstrate that the proposed wetland achieves greater than 20% betterment against calculated greenfield runoff volumes across all assessed storm events, including the 1-in-100 year plus 40% climate change scenario (see Table 1).

Table 1: Comparison of greenfield runoff volumes to runoff volumes of the proposed wetland under varying weather events. Modelling used 1-hour duration rainfall data from FEH

Event	Greenfield Runoff (m ³)	Wetland Runoff (m ³)	Betterment
1-in-1 year	4,691.20	3,103.58	33.84 %
1-in-30 years	19,517.35	14,591.12	25.24 %
1-in-100 years	25,719.54	19,537.37	24.04 %
1-in-100 years +40%	37,366.45	29,378.95	21.38 %



Appendices

Appendix 1

Appendix 1 contains copies of the rainfall data purchased from UK Centre for Ecology and Hydrology's Flood Estimation Handbook (FEH).

Table 2: Data sourced from the UK Centre for Ecology and Hydrology showing Rainfall Data for a central point (ST 99597 768120) within Stockham Marsh wetland.

Descriptor	Value
NGR	ST 99597 76812
BFIHOST	0.319
BFIHOST19	0.32
BFIHOST19SCALED	0.32
PROPWET	0.34
SAAR6190	710 mm
SAAR9120	726 mm

Table 3: Data sourced from the UK Centre for Ecology and Hydrology showing Rainfall Depths for a central point (ST 99597 768120) within Stockham Marsh wetland. Rainfall modelled under FEH22, the UK's latest depth-duration frequency (DDF) statistical model.

FEH Rainfall Data for Stockham Marsh							
Duration (hours)	Rainfall Depth (mm)						
	1-in-1 year	1-in-30 years	1-in-100 years	1-in-100 years + 40% (climate change)	1-in-100 years +50%	1-in-200 years	1-in-500 years
1	9.27	29.47	38.29	53.61	57.44	43.95	52.46
3	16.15	40.5	51.72	72.41	77.58	59.43	71.43
6	21.23	49.17	63.27	88.58	94.91	73.23	88.23
12	26.37	58.9	76.93	107.70	115.40	89.33	106.6
24	31.59	69.1	90.58	126.81	135.87	104.47	123.2



Appendix 2

Please refer to the zipped files included with this report, titled "Appendix 2 - Scalgo Modelling." These files contain modelling results for both pre- and post-wetland creation for all storm events over durations of 1, 3, 6, 12, and 24 hours.

